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Editorial Notes

The Institution Meeting

MANY features combined to add interest and significance to this year's General Meeting of The Institution of Gas Engineers, which was held last week under the Presidency of Mr. Robert Robertson, of Bristol. The attendance was a record—only 62 short of the 2,000 mark—and it was a matter for extreme gratification that so many eminent delegates and gas engineers from overseas honoured the meeting. Not for a long time, we think, has the Institution welcomed so many distinguished visitors from overseas. Then the death of the founder of the British Gas Industry, William Murdoch, was commemorated by a Centenary Memorial Lecture delivered by Dr. E. F. Armstrong. Also to mark the Centenary, a symposium on "The Gas Industry Overseas" was presented, compiled by men of high standing in the Industry in other countries. Both the Lecture and the symposium are valuable records.

Another highly important feature of the meeting was the announcement by Mr. H. C. Smith of the steps which have been taken in regard to Gas Industry research in this country. Briefly, a Gas Research Board is to be set up, and Sir David Milne-Watson has consented to become the first President of the Board. Among many objects of the Board will be the establishment of a bureau of information for the benefit of members, and a whole-time Director of Research is to be appointed. It is obvious that on the choice of the Director much of the success of the scheme will depend. The Board will take over the duties of the present Research Executive Committee of the Institution so far as these duties are concerned with fundamental research. It is not intended that an immediate application should be made to the Department of Scientific and Industrial Research for financial aid. The Board is to be given a preliminary run to ascertain how effectively the two sides of the Industry—the gas manufacturing and supply side, and the makers of gas plant and appliances—can work together. A constitution has, however, been designed which should meet the approval of the D.S.I.R. should it be decided at a later date to apply for a grant.

In his Presidential Address Mr. Robertson touched upon a matter on which we have had a good deal to say—the undue length of technical communications. He urged, as we also have asked, that authors should be more concise. He expressed the opinion that the publications of all technical associations would benefit by more drastic editing. His remarks concerning the erudite communications of the specialists and the research workers were very much to the point. The publication of a detailed account may be necessary to cater for the specialist reader, he said, but the specialist should cultivate the technique of presenting the practical aspect in an abbreviated form which can be readily understood and easily assimilated by the general practitioner.

Of the Papers presented at the meeting, three were accounts of new practice and new investigation. That by Mr. Grogono and Mr. Finlayson dealing with the Woodall-Duckham static vertical retort typified the tradition of co-operation between gas undertaking and plant constructor, and was extremely well received. That by Mr. Croft set out the working results of the installation of tower purifiers at the Wandsworth Gas-Works—the first of their kind to be erected in England. The Paper on "Comfort Heating by Gas" by Mr. Andrew and Mr. Barron contained ideas which we hope and believe will go a long way towards the development of the space heating load on an extensive scale.

Criticism of the meeting may perhaps be levelled on the score that it savoured too much of an autumn research meeting. With the march of events and increasing specialization this is to some extent inevitable. But the discussion on one of the Papers had about it an air of unreality and artificiality foreign to the June meetings of years long past, when the discussions were not so highly "engineered." The organization of the meeting, however, throughout left nothing to be desired, and reflected the greatest credit on Dr. Braunholtz and his staff, whose work increases yearly.

THE PRESIDENT,

ROBERT ROBERTSON, M.Inst.C.E.,

Engineer and Works Manager, Bristol Gas Company.

THE INSTITUTION OF GAS ENGINEERS

The "JOURNAL" Reviews the Annual Meeting

IN the brightest of sunshine—typical Institution week weather—Mr. Robert Robertson, of Bristol, on Tuesday morning last week rose to a packed audience of Members of the Institution and friends from overseas at the 76th Annual General Meeting. The meeting was noteworthy in many respects, and a most gratifying feature was the large number of distinguished visitors from overseas. We cannot remember a more representative gathering of the Industry of this and other countries. The reason may lie to some extent at least in the fact that this year the Institution commemorated by a Memorial Lecture the Centenary of the death of William Murdoch, that great engineer whose fertile ideas and inventive genius led to the foundation of one of the country's greatest industries. Whatever the cause, everyone was delighted to welcome their fellow gas engineers from other parts of the world—a welcome all the more significant in the light of international political tension.

Mr. Robertson's first duty was to extend to these visitors a hearty welcome on behalf of the Institution. The visitors included the President of the International Gas Union (Herr Hermann Müller, of Dessau) and two Past-Presidents of the International Gas Union, in the persons of M. A. Baril, of Paris, and Herr Fritz Escher, of Zurich. The meeting was honoured, too, by the presence of many official delegates from overseas gas associations. Representing the Belgian Association of Gas Engineers were M. J. de Brouwer, who is also Vice-President of the International Gas Union, and M. M. Perier. MM. C. Desanges and J. Ellissen were present on behalf of the French Gas Union, and Dr. H. C. Gerdes and Herr W. Nowakowski were representing the German Association of Gas and Water Engineers. For the Netherlands Gas Association, Professor Brender à Brandis, again a Vice-President of the International Gas Union, was present. Mr. J. C. Irminger, who has attended Institution meetings on many occasions, was there on behalf of the Norwegian Gas-Works Association. The Polish Association of Gas and Water Engineers, and the Economic Union of Gas and Water Works of Poland, were represented by Dr. B. Roga; the Swedish Gas Works Association by Mr. C. W. Pilo; the Swiss Gas and Water Association by Colonel H. Zollikofer, who is also General Secretary of the International Gas Union.

Other overseas visitors and members were Mr. W. J. Baker (Shanghai), Dr. M. Böhm (Milan), Vice-President, the International Gas Union, Signor A. Böhm (Milan), and Messrs. B. F. Browne (Santos), A. J. C. Bult (Victoria), A. E. Chadwick (Melbourne), B. Darker (Brisbane), C. G. Driessen (Maastricht), J. P. C. Handy (Sao Paulo), K. F. Keeble (Buenos Aires), J. M. Macfarlane (Melbourne), J. N. Reeson (Melbourne), H. E. Stone (Hong Kong).

The Gas Industry Overseas.

FOLLOWING Mr. Robertson's address of welcome came the presentation, without discussion, of a symposium on "The Gas Industry Overseas." This Communication, which gave a clean-cut idea of the origin and development of the Gas Industry in other countries, consisted of a series of short articles by eminent representatives of the Industry overseas, and dealt with the past, present, and future of the Industry in their respective countries. Their account of how common difficulties were faced and overcome

will prove a valuable record and will be a source of reference for many years to come.

The Secretary, Dr. W. T. K. Braunholtz, then announced the receipt of messages of greeting from M. A. Tobler (President, Swiss Gas and Water Association), the Secretary of the Netherlands Gas Association, the President and the Managing Director of the American Gas Association, the President of the Belgian Association of Gas Engineers, the President of the Canadian Gas Association, the President of the Danish Gas Association, the General Secretary of the French Gas Association, the Managing Director of the German Gas Association, and the President and the Secretary of the Yugo-Slavian Gas Association.

On the motion of the President, seconded by Mr. C. Valon Bennett, the 76th Annual Report of the Council for the year 1938-39, and the Accounts for the year 1938, were unanimously adopted. The Report showed an increase of Membership to 1,700.

The Question of Salaries.

MR. BENNETT took the opportunity to refer especially to the vital need for attracting to the ranks of the Industry properly trained men of the right type. "Speaking very frankly," he said, "I have my doubts whether that will be achieved unless an effort is made to see that all in its service are adequately remunerated. I go further than that and say I am certain we shall not do so unless it is recognized that Chartered Gas Engineers are required by this Institution to qualify by training and examination and, therefore, must be paid salaries at least equal to those paid by like and competitive industries. It is with this in mind I ask whether you are able to give us any further information regarding the progress of the work dealing with the question of salaries. Please let me make it quite clear that I do not speak for myself, but for those who desire to join us. It is, of course, impossible for all of us at this Meeting to air our views, and, therefore, perhaps it is unfair for me to say anything further, except I believe if the question of salaries of those known as "Technical Assistants" could be settled, the remuneration of Chief Officers would automatically be corrected where an upward tendency is essential. I appreciate the magnitude of the task, especially when it is borne in mind that recently an undertaking of no mean size advertised for the services of a Chief Technical Assistant possessing the Higher Grade Certificate of this Institution, at a salary which is equal to 0·0081d. per therm produced."

In reply, Mr. Robertson explained that a great amount of attention had been given and was being given by the Council to this question of salaries. The matter had been referred to the District Associations, some of whom, but not all, had already stated their views. When all replies had been received the matter would be carried a stage further and he hoped ultimately they would arrive at a satisfactory solution.

Election of Officers.

THEN came the election of Officers. Mr. George Dixon was duly elected President for 1939-40 and Mr. R. W. Hunter, Vice-President for the term 1939-41. Mr. John Terrace was again elected Honorary Secretary, and Messrs. H. D. Madden and Alfred Morland, Auditors. The Ordinary Members of Council elected for 1939-42 were Messrs. E. Astbury, G. le B. Diamond, P. N. Langford, and W. W. Townsend.

The names of the District Members of Council nominated by the Affiliated District Gas Associations for 1939-40 were: Messrs. W. C. Chapman, Eastern Counties; H. Singleton, Manchester District; G. C. Pearson, Midland; Archibald Kellock, North British; R. H. Duxbury, North of England; F. Blackburn, Southern; and W. H. Johns, Wales and Monmouthshire.

Presentation of Medals.

WE then came to the Presentation of Medals. The Institution Gold Medal, 1938, was awarded to Mr. F. B. Richards for his Paper "Carbonization from a Plant Designer's Viewpoint," read at the Meeting of the Institution last June. The H. E. Jones London Medal, 1938, was awarded to Mr. E. V. Evans for his Paper "Considerations upon the Processing of Coal," read at the same Meeting; the Institution Silver Medal, 1938, to Mr. J. E. Blundell for his North British Paper on "Experiences and Impressions of Thirty Years in the Gas Industry"; and the Institution Bronze Medal, 1938, to Mr. W. S. Hubbard for a Paper on "Choice of Gas Storage," given to the Yorkshire Junior Gas Association.

Presidential Address.

MR. ROBERTSON then delivered his Presidential Address, in the course of which he remarked that certain suggestions have recently been made for improving the existing district organization of the Industry and the use to which it is put. One is that there should be more intimate collaboration between the Committees of the District Gas Associations and the District Committees of the other national bodies and another that a district technical service might be provided for production and distribution on lines similar to that of the Industrial Gas Development Centres, an organization which is doing good work in a very efficient way. The first, he said, has possibilities worth following up. The second has also possibilities in the direction of providing a comprehensive technical service which would be complementary to the services now being rendered by the National Gas Council and the British Commercial Gas Association in their respective spheres. This would be of special value to the smaller gas undertakings, not otherwise provided for, but the larger undertakings would also benefit and the district centre might even become the common centre of activity for the collection and dissemination of relevant information in connexion with all three services.

He urged that the publications of all technical associations would benefit from more drastic editing. The publication of a detailed account of research may, he said, be essential to the specialist reader similarly engaged but, if full practical value is to be derived from the labours of the specialist, it is essential that he should also cultivate the technique of presenting the practical aspect in an abbreviated form which will be readily understood and easily assimilated by the general practitioner.

Referring to education and training, Mr. Robertson remarked that while parallel courses are provided in Manufacture and Supply there is no recognition of the enhanced value of the double qualification, nor is there any incentive to obtain this since either alone is accepted by the Institution as sufficient educational qualification. There is no reason why the student should not qualify in both but this is seldom done, very few attempt the full course in Supply, and still fewer attempt the full course in both. Thus, while 101 have taken the Diploma in Manufacture since the scheme was inaugurated, only 9 have taken the Diploma in Supply and only 3 have taken both. It may be that the time required for both courses is a deterrent, but the more likely explanation of the apparent lack of interest is that the Industry does not yet, in practice, attach much importance to technical training for Gas Supply. If so, he said, it is a matter to be deplored, since the need for a high standard of technical knowledge to deal with the problems of distribution and utilization is today as great as that required for dealing with the problems of production, and this applies equally to the departmental official on the supply side and to the administrative head of an undertaking who may be responsible for both production and supply.

A vote of thanks to Mr. Robertson for his Address was proposed by Mr. S. E. Whitehead and seconded by Mr. J. Wesley Whimster. The vote was carried with enthusiasm and the President briefly responded.

Murdoch's Centenary Lecture.

THIS brought us to the final item of the session on Tuesday morning — delivery by Dr. E. F. Armstrong of the Murdoch Centenary Lecture, in which he considered the founders of the Gas Industry, Murdoch, Clegg, and Winsor. This will prove a most valuable record.

Proposing a vote of thanks, Mr. D. M. Henshaw, Member of Council, said Dr. Armstrong had with thoroughness and enthusiasm, and possessing a mind trained in research, presented to them a remarkable digest not only of those great

THE INSTITUTION MEDALLISTS

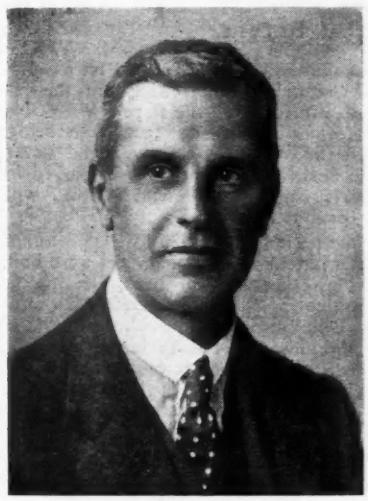
GOLD MEDAL

Awarded to F. B. Richards, M.B.E., M.Inst.C.E., M.I.Mech.E., M.Inst.Gas E., for a Paper on "Carbonization from a Plant Designer's Viewpoint," read at the 75th Annual General Meeting of The Institution of Gas Engineers in London on May 31, 1938.

F. B. RICHARDS
(Chairman of the Woodall-Duckham Companies).

SILVER MEDAL

Awarded to J. E. Blundell, M.Inst.C.E., M.Inst.Gas E., for a Paper on "Experiences and Impressions of Thirty Years in the Gas Industry," read at the Annual Meeting of the North British Association of Gas Managers on Sept. 8, 1938.



J. E. BLUNDELL
(Lately retired from the position of Gas Engineer and Manager at Carlisle).

H. E. JONES LONDON MEDAL

Awarded to E. V. Evans, O.B.E., F.I.C., M.Inst.Gas E., for a Paper on "Considerations upon the Processing of Coal," read at the 75th Annual General Meeting of The Institution of Gas Engineers in London on May 31 1938.

E. V. EVANS
(General Manager of the South Metropolitan Gas Company).

BRONZE MEDAL

Awarded to W. S. Hubbard, Assoc.M.Inst.Gas E., A.M.I.Mech.E., for a Paper on "Choice of Gas Storage," read at a meeting of the Yorkshire Junior Gas Association on Jan 15, 1938.

W. S. HUBBARD
(Manager of the Leeds Gas Department's Meadow Lane Works).

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pioneers but of those who had since carried on the perfecting of the many functions and services arising out of the process of carbonizing coal. The Lecture would, he said, prove a standard work of reference and provide substantial proof that the Industry's strength lies in the intrinsic merits of its processes and of the products it offers. The vote of thanks was seconded by Mr. H. A. Aitken and carried with acclamation.

The Static Vertical Retort.

THE first Paper to be presented at the meeting was by Mr. W. Grogono and Mr. T. C. Finlayson on the test installation of static vertical retorts at Croydon Gas-Works—a Communication setting out the results of three years' work. Introducing the Paper, Mr. Grogono explained that the information must be regarded as being in the nature of an "interim report." However, the data presented, as well as the details of the methods employed in this example of large-scale commercial research work, will be of great service to the Gas Industry.

During the period from 1930 to 1935 a number of installations of intermittent vertical chambers were built in this country by various constructional firms. In one particular direction intermittent vertical chambers gave room for improvement, and that was in the quenching of the coke by water. Not only did this give rise to large volumes of dust-laden steam, which in certain cases created a nuisance, but also it led to an unnecessary loss of heat. Alternative means of effecting coke cooling naturally came under consideration. Further, during recent years much attention has been directed to the possibilities of improving the yield of gas from the carbonization of coal by what has generally become recognized as the controlled cracking of hydrocarbons in the presence of hydrogen. It was realized that if the advantages of the intermittent vertical chamber process could be associated with the advantages of the continuous vertical retort process as regards the extraction of cool coke and continuous steaming, an improvement in technique would result. These combined factors led the Woodall-Duckham Company in 1934 to design a new form of carbonizing plant which embodied the essential features of a patent taken out by Sir Arthur Duckham in 1930.

The design seemed to offer sufficient promise of success to justify the erection of a full-scale test plant to explore the possibilities of the new process. Accordingly an arrangement was reached whereby it was possible to erect the test installation at the Waddon Works of the Croydon Gas Company.

The Paper gave an account of the work carried out at Croydon during the period from April 20, 1936, when the plant was put to work, to Oct. 21, 1938, when it was shut down at the completion of the experimental programme. During the whole of this period all the manual operations were carried out by retort house employees of the Croydon Gas Company as part of their normal duties. Shift supervising staff was provided by the Woodall-Duckham Company. Thus, from the commencement, the plant was treated as a normal carbonizing unit, subject to normal attention.

The test plant was designed with the following objects in view: (i) To prove whether the proposed process of carbonization would work satisfactorily, and to ascertain by experience the best methods of operation; (ii) to determine whether the proposed methods of construction were likely to offer any difficulties on a commercial scale; and (iii) to ascertain yields of products when carbonizing various coals, with a sufficient degree of accuracy to enable a comparison to be made between the static vertical retort and other forms of carbonizing plant.

A section of the Paper was devoted to a description of the static vertical retort, from the point of view of both principles of construction and principles of operation. Then followed a description of the test plant as erected at Croydon. The experimental work carried out during 1936, 1937, and 1938 was described. It was recorded that at the conclusion of the testing programme the retort had carbonized 2,800 tons of coal, of which 2,000 tons were Durham Run-of-Mine coals. The retort had been under heat for 670 days. From the commencement of operation to the shutting down of the plant at the conclusion of the testing programme, no alterations or repairs to the static vertical retort were required. The methods employed in determining the yields of products of carbonization were also detailed.

Results Obtained at Croydon.

ON the coals tested, said Mr. Grogono, the static vertical retort appears to give a higher thermal yield than either intermittent vertical chambers or continuous vertical retorts. As the calorific value falls, the advantage of the static vertical retort in this respect generally increases. Broadly speaking, the properties of static vertical retort tars are intermediate between those of tar produced in coke ovens and in continuous vertical retorts.

The yield, grading, and characteristics of the coke made from different coals were also dealt with. The density of the coke is intermediate between that of coke made in intermittent vertical chambers and that of coke made in continuous vertical retorts. The characteristics of static vertical retort coke in an open vertical bar grate have been examined by means of a series of tests carried out at the Fuel Research Station, details of which tests were included in the Paper. The broad conclusion was reached that the influence of the type of coal is greater than the influence of the type of plant.

An Example of Co-Operation.

MR. WILLIAM CASH, who opened the discussion on the Paper, suggested that the three years' experimental work at Croydon provided an extraordinarily good illustration of the co-operation which exists between gas undertakings and plant constructors, and he congratulated the Woodall Duckham Company on the valuable work they had done. Mr. S. E. Whitehead, who has the first unit of W-D static verticals at Southampton, explained that the two most striking features of the plant in operation are first its smooth working in spite of its apparently complicated nature from a mechanical point of view, and secondly the greatly improved cleanliness of the process. He paid tribute to the design of the commercial plant, especially of the most ingenious charging car and of the extractor driving gear. "The static system," he said, "by reason of its construction and more complicated mechanical features, necessarily entails higher capital cost and maintenance charges than does the intermittent vertical chamber, and it may well be asked what do we get in return? We already have the advantage of greater cleanliness in operation. We obtain a dry coke and a higher tar yield, and I believe we possess (provided one is content to make a gas of lower calorific value) a more flexible unit. But the main proof of the pudding must lie in thermal yield, and if this proves to be on the commercial scale as good as that obtained from the Croydon experimental retort, the installation at Southampton will be amply justified."

The Authors stated in their Paper that the plant had been designed in such a manner that it would afford an increased yield of gaseous hydrocarbons; and Mr. E. V. Evans, who has done so much work on the subject of controlled cracking, said that a close examination of their detailed results supports their contention that the conditions of carbonization are such that hydrocarbons which would otherwise have been degraded into hydrogen and carbon are conserved. Mr. Evans gave a number of very valuable figures in support of their claim that a richer yield of volatile products is obtained by carbonization in static verticals than in horizontals.

Mr. H. C. Smith suggested that it would have been better had the Authors compared the results of the static plant with figures relating to more recent working than 1931 of intermittent verticals. He said that from a general review of the Paper it was evident that the static plant is not at the moment a competitor of the intermittent vertical chamber plant in the manufacture of gas having a calorific value above 525 B.Th.U. At the lower calorific values the static vertical retorts show great advantage over both continuous verticals and intermittent vertical chambers in the production of therms per ton, but until more information is available it is difficult to assess the value of the increased thermal production.

Both Mr. E. G. Stewart—who asked the Authors many questions—and Mr. H. Moys referred to the results obtained from a Westvertical plant installed in 1929 at the Shoreditch Works of the Gas Light and Coke Company, while Mr. T. C. Battersby outlined the results obtained from a Westvertical plant at the works of the Watford and St. Albans Company. Mr. Battersby said that the returns from the process indicate a low production cost per therm.

Distribution and Sales at Bristol.

THE other Paper on Tuesday afternoon was by Mr. N. S. Smith. This dealt specifically with the distribution and sales activities of the Bristol Gas Company. A survey of the functions of the organization was followed by a delineation of its various features in natural sequence. Financial administration, the Author explained, other than the control of expenditure on material and time, is the direct concern of the general management. The costing system within the department provides a complete analysis of distribution expenditure on mains and services, meters, appliances, and public lighting. A reasonable percentage is added to appliance and fitting costs, the profit being applied to maintenance and reduction of general service charges. Except where costs exceed the economic limit, mains are laid free.

The section heads have complete charge of the routine work and are responsible for the engagement of workmen other than staff employees. The Distribution Engineer exercises his control directly through these officials. Although each section is in some measure self contained, the work routine is designed to prevent overlapping. Centralized control is largely dependent on reports and records, which are of maximum value only if rendered promptly. A continuous system of stock checking is carried out. No matter what system is adopted for storekeeping, said Mr. Smith, occasional mistakes will occur. The latest records of the Bristol Gas Company show about 2 per cent. or errors. Real losses are almost negligible.

Transport by contract is uncommon among gas undertakings, but it has long been the practice of the Company. In addition to the contractor's driver, two men accompany each appliance van and one each mains lorry.

Concrete roads on new estates are becoming fairly common in the Bristol area. The cost to the Company of laying dual mains (the developer carrying out the excavation and reinstatement) is actually little more than that of a single main. Where roads have been reconstructed, and remade with concrete, single mains in the carriage way have been replaced by dual mains in the pavements. In one or two instances mainlaying jobs have been put out to contract, but the costs show no saving on work executed by the Company's own department.

A considerable portion of the Paper was devoted to sales, and attention was paid to market research. Most of the information was obtained by the canvassers, and the sale of apparatus during their visits defrayed the cost.

Until this year the only appliances offered on simple hire were "black" cookers, a very good quality cooker with green enamelled sheet steel sides. With the introduction in 1934 of terminal hire, the Company ceased to purchase "black" cookers. At that time the total number of cookers on the district was 98,266 of which 93 per cent. were "black." At the end of 1938 there were 113,297 cookers, 52 per cent. being "enamel." Despite the success of terminal hire and hire purchase, there are many consumers who will only install enamelled cookers on simple hire. To meet the requirements of such consumers, returned "black" cookers are now being enamelled and hired at an increased rental. "Free" maintenance is provided with appliances on hire purchase, while consumers' appliances, both industrial and domestic, are maintained labour free, any material used being charged at normal sale price.

There is only one showroom. In lieu of district showrooms, permanent displays are arranged on traders' premises. For canvassing in Bristol use has been made of selected fitters, but Mr. Smith explained that in order to increase the numbers it will be necessary to look elsewhere.

What About the Power Load?

OPENING the discussion, Mr. R. J. Rogers emphasized points in the Paper, without, however, adding many new suggestions. His emphasis on the low space heating load at Bristol—and Bristol is not unique in this respect—was timely, as were the remarks on tariffs by Mr. C. H. Chester, who also spoke in the discussion. Without a promotional tariff the space heating load will not be gained. In calculating a tariff, remarked Mr. Chester, one always arrived at the conclusion that revenue would be lost, but in practice the tariff had to be sold, and if properly sold against coal it would pay every time. With attractive tariffs his load in seven years had been doubled. Yet the rate of profit per therm sold had dropped only slightly. It was Colonel W. M. Carr who to our mind offered a most useful contribution to the discussion. He assured the meeting that gas at 6d. a therm can compete with any other form of energy for the production of power. His reason for saying that was experience of a diesel engine running on town gas with 7% fuel oil for the purpose of ignition. We think that much more will be heard of this.

A Gas Research Board.

THE concluding item of the Tuesday afternoon session of the meeting was the presentation by Mr. Harold C. Smith of a report of proposals for the conduct of co-operative research. His remarks were followed by a statement by Mr. E. V. Evans, Chairman of the Research Executive Committee of the Institution. Mr. Smith explained that it had been decided to form a "Gas Research Board" having the following objects, among others:

(*a*) To promote and finance research and other scientific work in connexion with the Gas Industry.

(*b*) To establish and maintain a Bureau of Information for the benefit of members of the Board.

(*c*) To encourage the discovery of inventions, improvements, processes, materials, and designs which seem capable of being used by members of the Board.

(*d*) To co-operate with, become a member of, or otherwise assist the research work of any association, institution or other body whose objects include scientific or industrial research in connexion with or of interest to the Gas Industry.

(*e*) If and when considered desirable, to establish and equip laboratories and to pay research workers whether in such laboratories or elsewhere for the conduct of research.

(*f*) To prepare and issue detailed reports for the confidential use of members of the Board.

Sir David Milne-Watson has consented to become the first President of the Board, and it is intended to appoint a full-time Director of Research. One of his first duties will be to set up a Bureau of Scientific and Technical Information. It is not intended that an immediate application should be made to the Department of Scientific and Industrial Research for financial aid. The idea is to prove that the success of the Board is assured before asking for a grant. Practically every gas undertaking and the majority of plant and appliance makers will be members of the Board. This was pointed out by Mr. Evans, who, in the course of his remarks, said: "There will be available for their use and help a Council, a Director, and a Bureau of Information. Such an organization must, if well administered, have the effect of enhancing the scientific basis of our Industry. We believe that by maintaining a central organization to investigate problems of a fundamental nature, and by ensuring that the new knowledge thus made available is communicated to members, the undertakings and manufacturers will be better placed to carry out investigations themselves with the object of applying the new knowledge to their own special problems. We hope, too, that the offices of the Board may become a central clearing house for those problems which are of too wide a scope to be

solved locally, and for observations made in one place that may have a wider sphere of application."

Non-Ferrous Metals.

THE session on Wednesday morning was started by presentation by Dr. Harold Moore of the Paper by himself and Mr. E. A. G. Liddiard on "Non-Ferrous Metals and the Gas Industry." In a summary to the Paper the Authors explained that, apart from corrosion-resistance, the individual non-ferrous metals have characteristics favouring their use in particular applications in the Gas Industry, especially in gas distribution and consumption. For example, aluminium, with its high reflectivity and resistance to tarnish, is used as a reflector in some types of gas fires and lights and, in the form of paint, serves to preserve constant temperature conditions in gasholders. Copper is readily fabricated and bent, has a high thermal conductivity and is easily tinned. It therefore finds application in the form of pipes, which can readily be bent or jointed, for the distribution of gas. Copper, tinned on the outside where it comes into contact with burnt gas, is extensively used in the construction of gas water heaters. Lead is chiefly remarkable for its ease of working, in addition to its exceptional resistance to certain forms of corrosion. Lead pipes supplied in coil form to minimize jointing are useful for gas distribution, particularly where the installation of pipes is complicated and difficult. Nickel, when associated with chromium as an alloying element in iron, forms a useful series of heat and corrosion resisting alloys, and is the best undercoating for chromium-plated articles. The low melting point of tin makes it useful as a coating metal or, when alloyed with lead in the form of solder, as a jointing material. Zinc-base alloys can be readily and cheaply die cast to form parts of gas meters, but the main use of zinc is as a corrosion-resisting coating to iron and steel.

Research and development work on non-ferrous metals and alloys is widening their field of use and, in common with other industries, the Gas Industry is reaping the benefit of this work as materials more suitable for particular purposes are constantly being discovered.

Use of Stainless Steel.

OPENING the discussion, Mr. S. F. Dunkley expressed the opinion that in the Gas Industry there is a growing tendency towards replacing certain non-ferrous metals by stainless steel and heat-resisting steel. In the case of appliances and flue pipes which are exposed to heat, products of combustion, and domestic kitchen conditions, vitreous enamel is employed as a protection. Mr. Dunkley suggested that many electro-deposited non-ferrous coats of normal thickness would fail under the combined action of fruit juices, abrasion, blows, and so on, which the average vitreous enamelled cooker withstands. Mr. F. Latimer, of I.C.I., Ltd., spoke of the increasing use in America of copper pipes for gas distribution, while Mr. G. A. Andrew, of the British Aluminium Company, referred to the use of aluminium alloys for die-cast burners in America. Mr. T. G. Noble was in critical mood, suggesting that the Authors had made a number of statements which, to say the least, were unduly optimistic and in one or two cases misleading. The Authors showed little if any recognition of the basic differences between the operating conditions of "condensing" and "non-condensing" water heaters. The general impression received was that the Authors were thinking of corrosion in terms of academic tests on the loss of weight or degree of penetration of metals and their effect on the life of appliances. The Gas Industry objected to corrosion because a corroded flueway might ultimately become a source of danger, because corrosion products led to complaints, and because they put up maintenance costs and restricted possibilities in design. The problem had, in fact, much more to it than the Paper suggested. Mr. Liddiard, in reply, said they were not there to point out the difficulties of non-ferrous materials, but there was no doubt that gas, particularly when it contained sulphur, was difficult to handle without running the risk of corrosion. He hoped that co-operation between the Gas Industry and the metallurgical industry would solve difficulties.

Benevolent Fund.

AT this stage in the proceedings the general meeting of the contributors to the Benevolent Fund of the Institution was held, a report of which appears in this issue of the "JOURNAL."

Comfort by Gas Heating.

ON the resumption of the Institution meeting Mr. L. W. Andrew introduced the Paper by himself and Mr. A. Barron on "Comfort by Gas Heating." He put on the screen two lantern slides. The first contained four pictures of a coal fire. It showed such a fire at its peak, the flaming above the coal being at its maximum, and three further illustrations of the same fire at intervals of twenty minutes, showing how quickly the flames died down. Mr. Andrew commented that for some queer reason people usually thought of a coal fire only at its maximum flaming condition. His second slide illustrated the method suggested in the Paper for producing a gas fire to replace coal. It showed two illustrations of such a fire, one at the full gas rate and the other at half the full gas rate. The fire in both cases was bright and attractive.

The Paper itself considered the extent to which gas can economically provide the maximum comfort in domestic and non-domestic premises. Comfort was considered generally, and then domestic space heating and non-domestic space heating were dealt with in separate sections.

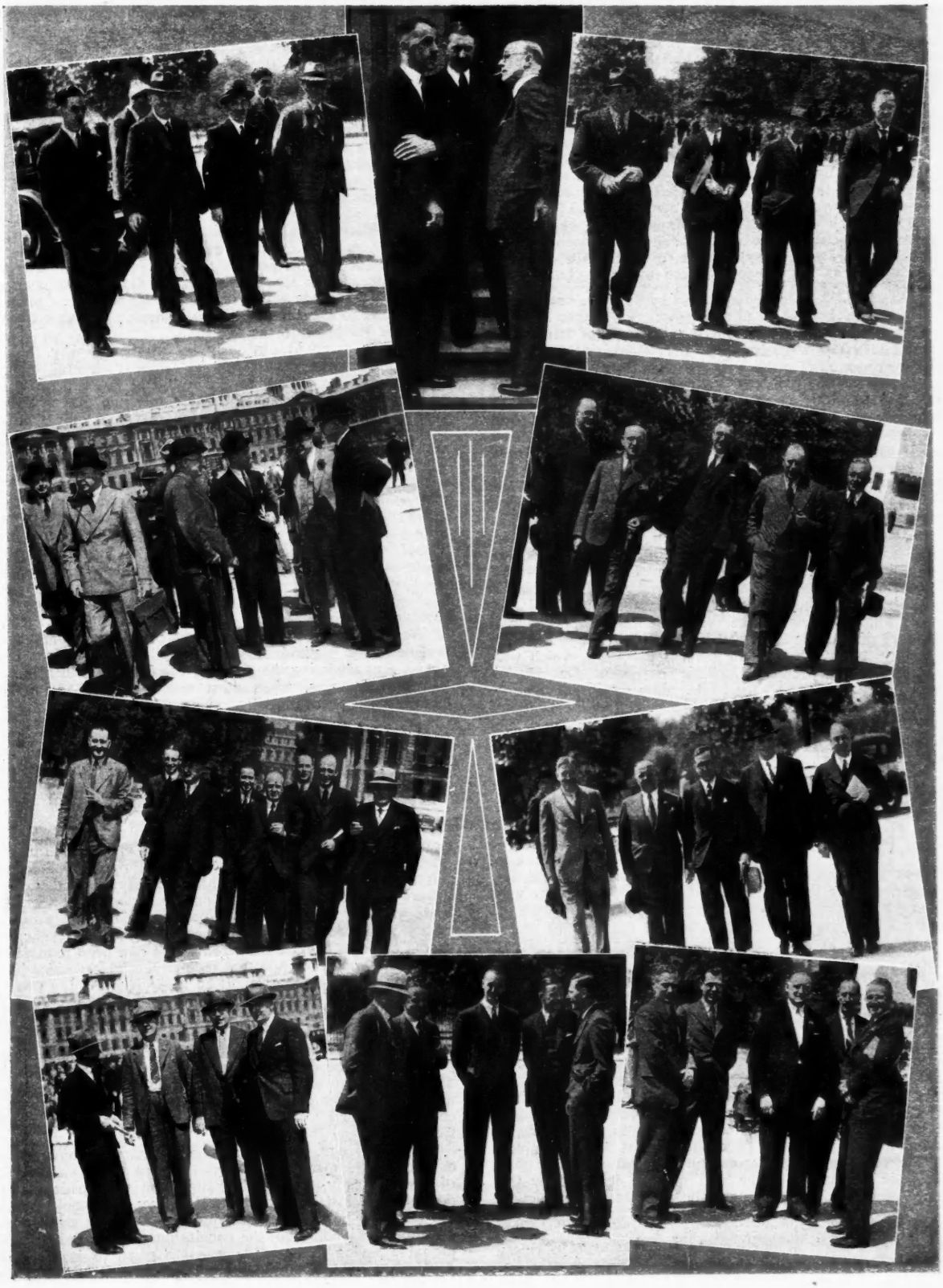
The existing information on comfort was summarized, as the factors giving comfort must be understood if gas is to be applied in the best way. Although the temperate climate of this country makes it possible to use an open fire as the main source of domestic heating, this method alone, the Authors suggested, does not give the most economical heating or the most desirable comfort conditions in one room or in the whole house. A section on domestic heating dealt with the recent technical development of appliances and then the comparative costs of heating by gas, solid fuel, and electricity. Special reference was made to the open coal fire in the living room.

It was shown that gas heating is in a remarkably favourable position if a house is considered as a whole. If gas can be purchased on a two-part tariff an unusually high standard of comfort is given in an all-gas house at a very reasonable cost. If gas is more expensive the present normal comfort standard can be much improved at a low cost. The open coal fire can be replaced by an open gas fire. This will generally only be practicable on a two-part tariff, as gas should be about 5d. per therm for use in the main living room instead of coal at 2s. 6d. a cwt. Present comfort standards, said Mr. Andrew, can be improved by the proper use of existing and additional gas appliances. Such an improvement is obtained by increased usage of independent flueless heaters in rooms and in the hall to give a warm house, particularly during the cold spells of weather which occur intermittently during the winter. It is essential that the consumer should realize the small annual cost of providing this extra comfort. The total annual fuel bill of a house in which any form of open fire is used as the sole method of heating can be decreased by the intelligent use of a flueless fire in the mild weather even on flat rate gas.

Although the estimates of cost given were largely theoretical, the figures were confirmed by practical data from a series of tests in three rooms heated throughout the last winter by coal, coke, and gas fires. Since the Paper was printed, Mr. Andrew explained, figures are available on a home test of about 50 inset fires of a new type fitted in living rooms on check meters in the Gas Light and Coke Company's area. Eleven people were able to give a reasonable estimate of the amount of coal used during the previous year and six people the amount of coke. Gas proved competitive on cost at 5·4d. per therm compared with coal, and 3·4d. per therm compared with open fire coke. The average annual consumption was 220 therms.

Central heating by hot water using gas as the fuel was considered for domestic and non-domestic premises. The intrinsic advantages of gas compared with solid fuel will often lead to its use in private houses, offices, and blocks of flats, but particularly in large installations the overall annual

SNAPPED AT THE MEETING



cost of heating may be the determining factor. The method used by the Gas Light and Coke Company for estimating the overall annual cost was given in some detail, and the figures were confirmed by practical example. It was pointed out that in private houses background heating by independent unit is often a desirable alternative. In heating non-domestic premises emphasis was placed on direct gas-fired units, which can frequently provide the maximum comfort at the minimum cost. These direct methods take full advantage of the flexibility of gas.

The final section of the Paper set out to anticipate the future development of gas appliances both for domestic and non-domestic use. An estimate of the potential annual consumption of space heating appliances for domestic purposes indicates that by the correct use of gas under conditions economical to the consumer the space heating load might well double the present domestic consumption. The most important single factor to bring about such a change, the Authors suggested, is the introduction of an open gas fire sufficiently attractive in appearance to replace the coal fire. Such a fire has not previously been available, but it is a practical possibility.

Nose Stuffiness.

SIR LEONARD HILL, the first speaker in the discussion, dilated not for the first time on the peculiar effects of radiation on the opening and closing of noses, a phenomenon which another speaker, Dr. Thomas Bedford, enlarged upon. As a result of experiment, he said, he had found that any form of heating of the skin might provoke stuffiness in the nose, whether that heating was by radiation, by convection, or by direct induction. One could put a hot fomentation on a man's arm and give him a stuffy nose. Any of the types of radiation he had tried would provoke that stuffiness—sun radiation would do it. Dr. Margaret Fishenden urged that more thought should be given to the geometrical distribution of heat from a gas fire, and Dr. Harold Hartley outlined the work of his firm, Radiation Ltd., in producing a gas fire with "full radiator" effect and, employing luminous flames, with complete silence. The fire had the additional advantage of emitting energy of high penetrancy approaching in quality that yielded by the clinical gas lamp, which was designed originally for therapeutic purposes. Dr. H. T. Angus called attention to the contribution which gas lighting makes to heating, referring especially to factory heating; and Mr. W. E. Benton also expressed surprise that the Authors had not mentioned the help which gas lighting can be to heat comfort.

Tower Purifiers.

ON Thursday morning Mr. C. M. Croft presented his Paper on the Installation of Tower Gas Purifiers at Wandsworth. He said the reason for the installation of this large addition to the purifying plant was due to the fact that, following absorption or amalgamation of other neighbouring companies during the previous 10 years, it was decided to manufacture as much gas as possible at Wandsworth where the works are situated on the banks of the River Thames and where coals are delivered direct by sea-going colliers. The increased manufacture of gas at Wandsworth, of necessity, caused a reduction in the gas made at the other works. But, as in all cases the works were smaller than Wandsworth, it is obvious that the plant thus rendered redundant was not of a size which would make it economical to move and re-erect at Wandsworth.

The land scheduled for gas manufacture at Wandsworth is only some 28 acres in extent, and consequently the greatest use has to be made of the undeveloped land. With this in view, different systems of purification plant were examined and the following points came up automatically for consideration: Reduction in the area of land occupied by the plant; lower cost in construction and maintenance; reduction in the handling costs and the time required for changing the material for the boxes.

It was as a result of this investigation that tower purifiers obviously presented many advantages which, if satisfactory in working, would suit the requirements at Wandsworth. Therefore, it was decided to install a plant capable of dealing nominally with 10 million cu.ft. of gas per day.

The Paper described in full the details of construction of the plant, the working of the plant, capital cost, method of working, and financial aspects, from both the capital and the economic points of view. Mr. Croft said that the first considerations which determined the choice of this type of plant had in practice been warranted more than was anticipated. He put forward the following points additional to those made in his Paper:

The first concerned the allowance of oxide. In normal English practice it is customary to allow from 8 to 10 cu.ft. of oxide per 1,000 cu.ft. of gas per day to be purified, but this plant is designed for only 6·6 cu.ft. of oxide per 1,000 cu.ft. of gas per day. At Christmas the purifiers were working at an overload of almost 33% and still gave satisfactory service, which proves that the figure of 6·6 cu.ft. of oxide per 1,000 cu.ft. of gas per day in this type of purifier is adequate for English practice. Thirty per cent. of Lux has been added, at the specification of the German designers, to the normal bog ore which it is the custom of the Company to use, and to this fact, of course, considerably more efficacy might be attributed to the oxide.

Secondly, it could obviously be questioned why this installation consists of six towers whereas general opinion might consider that four towers would be less expensive and equally efficient. Against this Mr. Croft said that when this type of plant was being considered they had only German practice on which to form conclusions. Further reasons which led them to decide to install six towers of the present size were: Had there been only four towers, these would of necessity have had to be increased in size, and it was felt that with fewer towers each proportionately larger, such greater physical conditions would prevail as to make the towers heavier in design and more expensive in construction. Therefore, very little cost, if any, would be saved on the construction of the towers themselves. Another point, and a very important one, presented itself—namely, that an overhead gantry with a lifting transporter had to be provided, capable of lifting loads up to 50 tons. Again, the method at Wandsworth is to work without catch-boxes, and, by a predetermined method of swinging, all the towers are kept active, thus obviating the need for catch-boxes, which in certain circumstances, when most necessary, are apt to fail owing to lack of continuous activation.

Removal of Hydrocyanic Acid.

IN the discussion on the Paper, Mr. E. V. Evans said he did not know whether it was generally accepted in the Industry that the process of purification by oxide of iron should be operated in such a manner that hydrocyanic acid was extracted as well as hydrogen sulphide. It was a most corrosive constituent, especially when there was a trace of ammonia in the gas, and its action on copper and brass was very destructive. To perform this double purification process adequately it was necessary that the crude gas should come in contact with iron which had been reduced to the ferrous condition, and that requirement placed some limit upon the variations that might be made in operating details. It was also important that the process should be worked in such a manner that the gas leaving the purifiers was of low oxygen content. Records which had been collected over a number of years relative to the operation of rectangular box purifiers revealed that it was possible, on the average, to obtain sufficient revenue from spent oxide to meet the cost of new purifying material, while labour charges on the process could be limited to approximately 0·05d. per therm of gas treated.

Some years ago, when it became necessary to construct an additional stream of purifiers at the East Greenwich works of his Company, a careful examination was made of the possibility of installing mechanical devices that would enable the boxes to be charged and discharged with a smaller expenditure on labour; but the conclusion was reached that the probable saving to be made was too small to justify such equipment and, as ample ground space was available, the

usual type of rectangular box at ground level was chosen. It was of interest to observe that the capital cost of the installation, amounting to just under £45,000 for an 8,000,000 stream, was proportionately equal to Mr. Croft's figure of £58,000 for a 10,000,000 stream.

Mr. G. C. Pearson explained that they had under consideration in Birmingham a lay-out of purifiers for a proposed extension of an existing works and had been awaiting with interest the Wandsworth results. He expressed regret that the working costs of tower purifiers showed no saving over the rectangular boxes. The estimated cost per therm with tower purifiers was 0·0343d. This would be regarded as high in Birmingham, where they had a purification cost of 0·0124d. per therm averaged over a period of ten years.

Mr. K. W. Francombe, referring to the question of capital cost, wondered whether the electro-detarring plant, which came before the tower purifiers and which was doubtless put in to safeguard the state of the oxide inside the towers, would have been included if ordinary boxes had been used. He hoped the answer to the question would be in the affirmative. If not, then the capital cost of the electro-detarring plant had to be added to that of the towers. The same remarks applied to the Harrison purging machine.

Mr. G. M. Gill wondered whether Mr. Croft had considered complete internal revivification of the oxide. In the United States, he said, it had been the practice in a number of large works, especially in Philadelphia and Milwaukee, to revivify the oxide completely in the boxes. With competent chemical supervision there was no risk in it at all. It seemed that the system of tower purifiers lent itself very well to that method. He knew that Mr. Croft was able to increase the new oxide to a sulphur percentage of 45%, but by the method he had explained it was possible that that percentage could be increased.

By-Product Ammonia.

THE final Paper at the meeting was by Mr. P. Parrish on by-product ammonia. In his presentation he mentioned that the necessity for combining as much ammonia with sulphur as possible was repeatedly urged in his Paper. He went on to say that these minor products of the processing of coal—namely, ammonia and sulphur—would be of inestimable value to this country in time of emergency. They were certainly of economic importance in periods of peace, and their recovery was inevitable, in any case. The fact that their production was distributed throughout the country was of notable significance.

It was, he continued, unfortunate that no direct process of combination had been evolved by which a readily saleable product could be manufactured. Many attempts had been made, and much time and money expended, in this direction, but all unavailingly. That Germany attached great importance to the recovery of sulphur was evidenced by the fact that she was enlarging her existing plants to ensure an annual production of 60,000 tons of sulphur, from coke oven gas, despite the fact that the cost of production was known to be more than twice that at which Sicilian or Texas Gulf sulphur could be purchased.

The automatic processes for the concentration of gas liquor described in the Paper afforded the best known methods of conserving ammonia and sulphur in a readily-utilizable form. Apparently nothing quite so promising had hitherto been possible. Gas liquor had been concentrated at two works for some time now, containing 18 to 22 units of ammonia and 8 to 10 units of sulphur, proportions almost adequate to ensure the direct formation of 50% of the ammonia as ammonium sulphate. The essential substances were released by dissociation in a distillation unit, the ammonia was absorbed in sulphuric acid, and ammonium sulphate of satisfactory chemical composition and attractive crystal size was produced. The hydrogen sulphide passed to a sulphuric acid plant and was converted by combustion, oxidation, and reaction with water, to sulphuric acid. By combining these two processes, one could manufacture ammonium sulphate under the most economic conditions conceivable, with minimum handling, and an assured high efficiency of recovery. If gas liquor of such qualtiy could be manufactured at two works carbonizing coal, it seemed reasonable to assume that methods existed by which the ammonia formed in the carbonization of coal could be utilized to a greater extent in the recovery of hydrogen sulphide than was normally practised at most gas-works at the present time.

If a suitable quality of gas liquor was produced, and recommended methods of automatic concentration were pursued, the ultimate product, if utilized at a central chemical works, could ensure a much higher revenue for ammonia and sulphur than had hitherto been possible. Indeed, the revenue could be substantial, if one was prepared to manufacture a number of fertlizer products in economic units.

Economic Soundness.

OPENING the discussion on the Paper, Mr. E. V. Evans endorsed the Author's remarks as to the economic soundness of the system whereby ammoniacal liquor was concentrated at an individual gas-works and then sent to a central chemical works to be worked up finally into sulphate of ammonia. Mr. C. F. Botley explained that at the Glyne Gap Works of the Hastings Company concentration of liquor had been practised since 1905, more recently with automatic control. It could be confidently recommended even for small works, of which North Berwick was an outstanding example. Mr. F. C. O. Speyer suggested that a false impression had been given to the general public of the price which gas undertakings were realizing for sulphate of ammonia, owing to the fact that the price quoted for sulphate of ammonia in the home market included the cost of delivery to station, and Mr. Parrish suggested that all compound fertilizers containing N.P.K. were sold f.o.r. makers' works. The latter was no longer the case, as a considerable portion of the mixtures marketed by members of the Fertiliser Manufacturers' Association were now sold on a delivered basis, and that also applied to the concentrated complete fertilizers marketed by Imperial Chemical Industries, Limited. To this Mr. Parrish replied that the fact remained that if the season's prices for sulphate of ammonia for the last two years were taken, the gas-works should have realized something of the order of £7 9s. per ton, but the amount which had been paid by the British Sulphate of Ammonia Federation to works which were members of that organization was less than £6 per ton. In other words, to sell sulphate of ammonia cost something of the order of 35s. to 37s. 6d. per ton, an expense for which there was no justification.

Concluding Proceedings.

THE President then announced that the Research and Education Reports of the Institution for 1938-39 would be presented at the 11th Autumn Research Meeting in London on Nov. 21 and 22. He explained that the meeting would be held later than usual in the month of November, in order to synchronize with the date on which it was possible to hold the meeting of the British Gas Federation. He also reported that the 77th Annual General Meeting of the Institution would be held in London on June 4-7, 1940. Then came an omnibus vote of thanks to all who had contributed to the success of the meeting. This was proposed by Mr. Valon Bennett, who paid tribute to the work of the Secretary and his staff, and seconded by Mr. David Fulton. In the course of his reply, Dr. Braunholtz referred to the excellent attendance of engineers from overseas. It was, he said, a matter for extreme gratification that so many eminent overseas delegates and gas engineers had honoured them at the meeting, as well as overseas members of the Institution. Mr. George Dixon, President-Elect, voiced the meeting's thanks to Mr. Robertson for all he had done on their behalf. Mr. Dixon asked him to accept the certificate which recorded his Presidency of the Institution. The certificate was handed to Mr. Robertson, and the vote of thanks to him was accorded with the heartiest acclamation. Mr. Robertson's response brought the meeting to a close.

Presidential Address

OF

ROBERT ROBERTSON, M.Inst.C.E., M.Inst.Gas E.,

Engineer and Works Manager, Bristol Gas Company

A year ago I thanked members of this Institution for the honour they had conferred in electing me to be their President. Today, I would thank them again, but this time for the privileges attached to the office, chief among which is the intimate contact enjoyed with the executive life of the Institution and of other constituent members of the British Gas Federation and for the opportunities thus afforded of observing and taking part in their work. Another privilege enjoyed has been the opportunities of meeting the District Gas Associations and I have to thank both Seniors and Juniors for the welcome extended and for the stimulating experiences gained on many interesting occasions.

With these expressions of appreciation and thanks I have to mingle the confession that, with the best intentions, "I have left undone the things which I ought to have done and have done those things which I ought not to have done" and my only consolation is that whatever the transient occupant of the Presidential chair may or may not do is as nothing compared with the work of the Institution itself and it is upon this work I would venture to speak today. The subject is all the more appropriate because within the past twelve months the organization of the Gas Industry has been under review and the relationship between its various constituent bodies has been the subject of much careful consideration.

The Institution's Predecessors.

As the Chartered Institution of Gas Engineers we are the heirs and successors of a line of Associations, the first of which was founded in 1863 for "the encouragement and advancement of all matters connected with Gas Engineering, Manufacture and Finance" and "to facilitate the exchange of information and ideas among its members." Since then both name and constitution have been changed several times, each change representing a stage in the process whereby the spirit of the Industry has sought to adapt itself to its changing environment.

The present-day objects of the Institution, as set out in its Royal Charter, occupy much more space than did the objects of the first Association and, although no doubt they mean the same things, the fact that today they are specified in so much more detail is an indication that the Industry and the Institution have not been exempt from the influences which, during the same period, have changed all our national institutions from simpler to more complex forms.

Until the end of the last century the business of the Gas Industry had been comparatively simple, according to modern standards. The social and industrial developments of recent years, which have added so much to the complexity of life, were as yet so many impracticable dreams. The absence of competition and the ease with which the Victorian Gas Undertaking paid its maximum dividend encouraged contentment with established practice. No elaborate selling or servicing organizations were required for a business which consistently expanded even when conducted, as it often was, on "the take it or leave it" principle and when competition did become serious the effects were minimized by timely inventions for which the Industry was indebted mainly to private individuals or outside contractors.

Under such conditions our predecessors as the only national organization were called upon to deal with matters non-technical as well as technical but it is evident, from the Transactions of the period, that a change in outlook was taking place. Appreciation of modern tendencies and of the problems involved had been growing apace and in 1903 a newly-constituted Institution of Gas Engineers reflected the modern outlook and addressed itself without delay to the problems ahead. Since then it has consistently pursued two separate lines of progress and development, one concerned with matters of technical interest and the other with the non-technical problems arising from the changing conditions both inside and outside the Gas Industry.

Non-Technical Developments.

The most pressing of the non-technical problems which confronted the young Institution was the promotion of sales and service. There were other pioneers but the first Paper dealing comprehensively with the subject was presented by F. W. (later Sir Francis) Goodenough in 1907. In 1910 it was resolved to establish a Publicity Fund and in the following year the British Commercial Gas Association was formed under the auspices of the Institution. Shortly afterwards it became a separate organization but the Publicity Fund continued to be collected by the Institution until 1921.

Other developments, social, economic, legislative, the inevitable sequel to the march of progress, had, in the meantime, been creating other problems for the Industry. Early in the century commercial sections had been formed by the District Gas Associations for the study of such problems and the possibility of creating an organization more fully representative of the Industry as a whole now engaged the attention of the Institution. The Gas Companies Protection Association had been formed in 1898 but it was concerned mainly with Parliamentary business and had a limited membership which did not include the Municipal Undertakings. In 1914, a National Gas Committee was formed on which The Institution of Gas Engineers, the British Commercial Gas Association and the Society of British Gas Industries were equally represented, but this failed to meet the exacting demands of war-time conditions; something more representative was needed and in 1916, at a joint conference of The Institution of Gas Engineers, the Society of British Gas Industries, the British Commercial Gas Association and the Gas Companies Protection Association, the National Gas Council was formed.

During the post-war years the conditions which led to the developments referred to have become still more difficult and exacting. The State has become increasingly involved in social and industrial experiments, which form no part of any comprehensive plan and too often suggest considerations of expediency and the undue influence of political and commercial opportunism, with the result that the flow of trade which formerly followed the natural course determined by the law of supply and demand is now liable to be deflected in unexpected directions by tariffs, subsidies, preferential treatment and price control. Further, we have witnessed the growth of "big business" by amalgamation, ring and group control and the development of highly efficient trade organizations for the protection and promotion of special interests, each striving for economic advantages and competing for the patronage of the public in respect not only of the necessaries of life but also of its luxuries and not only for the money the public has to spend but also for what it hopes to have. Last, but not least, our competitors are employing the latest scientific methods and the most highly trained talent in the organization and direction of their operations and the investigation of their problems to the end that they may be able to provide better and cheaper services.

The need, therefore, of organized, co-operative and specialized effort is greater today than ever before, not only within the Gas Industry but wherever co-operation with kindred industries can replace competition which has ceased to be healthy for any of the parties concerned. To the organizations already referred to which have grown up within the Gas Industry there have been added other national and regional organizations, mainly co-operative in character, for the marketing of tar, benzole, sulphate of ammonia and coke and with each of these the Gas Industry is closely associated through Undertaking members and representatives who serve

on committees and councils. Wages and conditions of labour, too, are now the special business of the Federation of Gas Employers and the National Joint Industrial Gas Council; the supply of coal is no longer a simple matter for private negotiation and the aid of the national organization is invoked to obtain a "square deal" not only in respect of coal but gas charges, rating and other items in the Industry's budget. A minor result of these developments which I hope will be noted is that many matters which formerly provided suitable materials for a Presidential Address are now the special business of highly trained staff officers and their executive committees.

District Gas Associations.

Sufficient has been said to indicate that the policy of the Institution towards non-technical developments in the Industry has consistently favoured the creation of special organizations to deal with such developments. It has consistently taken the initiative or lent its aid in furthering this policy and has, in consequence, been left increasingly free, since the process of devolution began, to pursue its own particular task, the furthering of the technical, professional and educational interests of the Gas Industry.

First in order was the movement for the establishment of more direct contact between the Institution and the District Gas Associations. Within a few years most of the senior Associations had become affiliated and, as a result of the direct district representation on the Council thus provided, the Institution can claim to be representative of the technical interests of the Industry as a whole.

The means available for "the exchange of information and ideas" are today legion, but the general meetings of the Institution and the District Gas Associations remain the chief occasions for the presentation of official communications and for the discussion of problems of general interest. Less conspicuous, but also important, are the opportunities these formal occasions give for the making of contacts and for informal discussions which are all the more frank, informing and truth revealing because unrecorded, thus providing on occasion correctives to impressions created by more discreetly worded formal Papers. Between these extremes of the formal and the informal, the commercial sections of the District Gas Associations provide for the regular discussion of markets and "other competent business". Such discussions, conducted *in camera* and particularly when led by someone who has made a special study of the subject under discussion, are of the greatest possible value in extracting the proverbial wisdom from the multitude of counsellors.

Certain suggestions have recently been made for improving the existing district organization of the Industry and the use to which it is put; one is that there should be more intimate collaboration between the Committees of the District Gas Associations and the District Committees of the other national bodies and another that a district technical service might be provided for production and distribution on lines similar to that of the Industrial Gas Development Centres, an organization which is doing good work in a very efficient way. The first has possibilities worth following up. The second has also possibilities in the direction of providing a comprehensive technical service which would be complementary to the services now being rendered by the National Gas Council and the British Commercial Gas Association in their respective spheres. This would be of special value to the smaller Gas Undertakings, not otherwise provided for, but the larger Undertakings would also benefit and the district centre might even become the common centre of activity for the collection and dissemination of relevant information in connexion with all three services.

Benevolent Fund.

Another more domestic matter in connexion with which the collaboration of the District Gas Associations is now being sought is the Benevolent Fund of the Institution. The object of this Fund is to provide financial assistance to members or their dependants who are in straitened circumstances in consequence of misfortune, sickness or death. Over 40 per cent. of the members do not subscribe to the Fund and the grants which it has hitherto been possible to make have been comparatively small, so small that the Committee of Management has recently decided to anticipate the increase it hopes will follow from the local effort, now being organized, by increasing the grants. In commending the Fund to the sympathetic consideration of members I sincerely hope that the Committee's action will prove to be intelligent anticipation.

The Transactions.

The transactions of the Institution and of the District Gas Associations and the columns of the Technical Press devoted to these are a source of information which, if assimilated, would be of great value to the Industry. We are, however, confronted with a difficulty which is all the greater because many of our members are also members of other technical bodies and interested in their transactions, committees add their quota in the form of minutes, while industrial legislation and State departmental reports swell the continuous, voluminous and unregulated stream of technical literature. If it could be said of a mere trickle of literature 3,000 years ago, "of making many books there is no end and much reading is a weariness of the flesh", what might be said of the present-day flood?

Since every branch of applied science is today inter-related to every other branch and a discovery in one may be of value in another, the technical worker who desires to keep in touch with all sources of information related to his business is confronted with a difficult task. It is unfortunately true that much that is written is more or less a repetition of what has already been written again and again. Further, lack of time to condense and lack of experience and training on the part of the occasional author are not conducive to brevity and conciseness. It may also be that iteration and re-iteration are essential to the propagation of ideas and that in literature, as in nature, prodigality in the distribution of the seed is necessary for survival but nature is also ruthless in discarding the redundant and I venture to think that the publications of all technical associations would benefit from more drastic editing.

Our greatly esteemed friends of the Technical Press, too, might set an example. In their zeal to serve the Industry they have, unfortunately, contributed to the difficulty by the multiplication of periodicals, special numbers and supplements. Might they not lend their powerful aid in the direction of simplification, if only by adopting a standard format and presenting carefully edited and suitably indexed contributions of permanent value on separate, detachable pages? These could, in turn, be transferred to suitable loose-leaf bindings and the bookshelves of the technical worker might then become compact repositories of up-to-date information instead of museums of obsolete practice and the ephemeral views of bygone days.

Another aspect of this problem is presented by the more erudite communications of the specialists and the research workers which frequently relate to investigations concerning highly complex processes which the general practitioner may have difficulty in following and may not even have time to read. The publication of a detailed account may be essential to the specialist reader similarly engaged but, if full practical value is to be derived from the labours of the specialist, it is essential that he should also cultivate the technique of presenting the practical aspect in an abbreviated form which will be readily understood and easily assimilated by the general practitioner.

In the absence of effective methods of dealing with the difficulty at its source, divers systems of abstracting and indexing have been evolved for its amelioration and the International Federation for Documentation, the special business of which is the study of this problem, has itself devised a system for the co-ordination and rationalization of scientific literature embracing all subjects in all languages. For the ordinary technical official, however, something simpler has to suffice; he has invariably to evolve his own system and, to the recently published recommendations of the Consultative Committee on Secondary Education, which emphasize the importance of "training in clear and precise expression of ideas in English", might well be added, "instruction in the elementary principles of abstracting, indexing and filing".

Education.

Another task to which the Institution has addressed itself since 1903 is education and training for the Gas Industry. The Industry had previously been content to leave education

first to the Royal Society of Arts and then to the City and Guilds of London Institute and to the private efforts of individual members. The need for something more than this vicarious interest had, however, become apparent and in 1907 the Council of The Institution of Gas Engineers became associated, in an advisory capacity, with the City and Guilds of London Institute respecting the scope of the syllabus and the choice of examiners.

Another important step was taken in 1910 when, on the initiative of the Institution, the Livesey Professorship of Coal Gas and Fuel Industries was endowed at the University of Leeds as a memorial to the late Sir George Livesey. Up to date, 134 students have graduated under the Livesey Professor and of these 99 have found positions in the gas, coke oven and refractories industries to the great advantage of these industries.

The next important step was taken in 1923 when a comprehensive scheme for the education and certification of those engaged in the technical work of the Gas Industry was adopted. The scheme, which was the product of collaboration between the representatives of the Institution, the City and Guilds of London Institute and the Board of Education, had for its object the education of both the craftsman and the technologist. It was designed to provide for the latter a high standard of technical equipment which its authors hoped would in time become the basis of qualification for membership of the Institution and, when the Royal Charter was granted in 1929, the new By-laws provided for this.

The ultimate ideal of any professional association is that membership shall be a guarantee of professional competence and a *sine qua non* of employment in any responsible position in the profession. The extent to which, in practice, this claim can be made good is determined largely by the standard of theoretical and practical qualifications required for membership and, in certain of the more exclusive professions, adequate training in both is regarded as essential to certification of competency in either. The original authors of the Education Scheme had this very much in mind and conditions were laid down which were intended to prevent anyone from obtaining the educational qualifications without at least having the opportunity of acquiring practical experience; also, the By-laws of the Institution were designed to ensure that only those with practical as well as theoretical qualifications were eligible for membership. It has, however, been difficult to carry out the original intention in respect of practical training in the administration of the Education Scheme and it has to be admitted that the By-laws of the Institution emphasize the importance of the position held by the candidate rather than the sufficiency of his practical training. The same considerations apply to those whose educational qualifications are approved university degrees. The courses are invariably of a highly specialized character and although lectures on works practice and holiday works courses may be arranged these are not compulsory and in any case would not alone suffice for the making of the "compleat" gas engineer.

Another aspect of the problem is that while parallel courses are provided in Manufacture and Supply there is no recognition of the enhanced value of the double qualification, nor is there any incentive to obtain this since either alone is accepted by the Institution as sufficient educational qualification. There is no reason why the student should not qualify in both but this is seldom done, very few attempt the full course in Supply and still fewer attempt the full course in both. Thus, while 101 have taken the Diploma in Manufacture, since the scheme was inaugurated, only 9 have taken the Diploma in Supply and only 3 have taken both. It may be that the time required for both courses is a deterrent, but the more likely explanation of the apparent lack of interest is that the Industry does not yet, in practice, attach much importance to technical training for Gas Supply. If so, it is a matter to be deplored, since the need for a high standard of technical knowledge to deal with the problems of distribution and utilization is today as great as that required for dealing with the problems of production and this applies equally to the departmental official on the supply side and to the administrative head of an Undertaking who may be responsible for both production and supply.

These observations are not intended to reflect upon the Education Scheme. Indeed, for some years it was my privilege, as a member of the Board of Examiners, to have intimate contact with the scheme in operation and I should like to pay tribute to the members of the Gas Education Committee and their collaborators for the skill and discernment displayed from the first in the endeavour to provide a uniform educational garment to fit so many different types of students and to serve so many different purposes; also to their readiness to alter and adapt the garment to fit the growing, changing needs of their clients. My object has rather been to draw attention to defects in the system of practical training and in the method of certification and to both in relation to membership of the Institution. It also affords the opportunity of emphasizing the need for collaboration on the part of Undertakings and of those in authority to provide for juniors the means of obtaining a practical training comparable in its completeness with the theoretical course which the scheme provides.

Another reflection of a somewhat different kind is that although the standard of engineering and chemical knowledge required for either of the courses referred to is moderately high it is not so high as that set by the universities and certain other professional institutions and this has a special significance because of certain modern tendencies. First in importance among these is the development of group control of Undertakings by amalgamation and holding company, a movement which since 1920 has been mainly responsible for reducing the number of free Undertakings in Great Britain from 1,443 to approximately 800. Though differing in certain important respects, both methods substitute central for multiple administration and offer possibilities of a higher standard in the control of both production and distribution. Similarly, in larger Undertakings the present tendency is towards sectionalizing and staffing with highly qualified specialists and the general effect of both tendencies is to reduce the number of positions of full individual responsibility, but to increase the number of positions for highly qualified engineers, chemists, physicists and technical salesmen; in other words, the general practitioners for whom the scheme was primarily designed are becoming less in number while the highly qualified technologists for whom the scheme was not designed are increasing. This fact has already been recognized and the By-laws of the Institution were amended in 1937 to make it possible for many highly qualified technical officials to become members of the Institution who had been barred by the original limiting educational qualifications and I venture to think that the Institution might benefit by still further broadening the basis of membership in this direction.

There is yet another aspect of the educational problem worthy of mention. While providing for the technical equipment required for positions of administrative responsibility the scheme makes no provision for training in administration itself. The importance of this qualification in modern business is evidenced by the large number of universities and technical colleges which now provide for instruction in various phases of business and industrial administration. Certain other professional institutions now include the fundamentals of industrial administration in their syllabus but, for the most part, these are left to be "picked up" in the school of experience. This is a matter which has not escaped the attention of the Gas Education Committee but the difficulty of adding another subject to an already extensive syllabus, while the time factor remains constant, is one which even the Education Committee has so far been unable to overcome.

This is not the place to discuss education for salesmanship and I would not presume to do so, but the technical equipment of the salesman is of importance to the Gas Industry. Opinion may differ as to the amount of technical knowledge he should possess, but it is safe to say the more the better and it is satisfactory to know that arrangements are now being made to provide what it is hoped will be a minimum standard course.

In this connexion one other reflection may be permitted. Personality and character still remain the most valuable of business assets—education cannot materially alter these and can only modify inherent native talent within narrow limits. Further, education as an end in itself does not have the popular appeal for the average youth which many other spare-time pursuits have. For both of these reasons, the result of any scheme depends upon the inducements offered by the Industry to talented youth to enter it and the incentive

offered, to those who have entered, to devote the necessary time and energy to making the most of the educational facilities provided. It is not unusual for attendance of approved classes to be made a condition of employment for juniors but the most effective inducement is, of course, the reward in the form of remuneration which the Industry has to bestow upon those who qualify. Judging from the salaries offered from time to time for vacancies advertised and still more from salaries paid where the vacancies are not advertised, the personnel of the Gas Industry is liable to suffer more from a lack of appreciation of the financial value of technical education than from any defects in the Education Scheme itself. Undertakings which seek to economize in this direction are doing a disservice both to themselves and to the Industry and the problem is now engaging the attention of the Council of The Institution of Gas Engineers and the Committees of the Affiliated District Gas Associations.

Research.

Another subject which has engaged the attention of the Institution since its foundation is organized research. Research is no new thing but the modern conception differs from that of the past inasmuch as it replaces the fortuitous effort of the individual—not too well equipped for the task, perhaps—by the organized effort in which the most highly trained and efficiently equipped forces are directed along carefully planned lines of enquiry. Paradoxically, the most valuable discoveries may be the result of chance and accident but the presence of the trained observer with the appropriate equipment does increase the possibilities of the discovery being made when the chance occurs or the accident happens. Further, the more extended the field of observation and the larger the number of observers working for a common purpose, the better the chances of success.

From time to time our predecessors discussed and passed resolutions regarding the desirability of organized research and, from time to time, special committees were appointed to investigate problems of the day but it was not until 1906 that any definite plan was brought into being. In that year a Special Purposes Fund was established, to maintain which Gas Undertakings were invited to subscribe at the rate of 6d. per mill. cu.ft. of gas made and it was announced that two investigations would be proceeded with:

(i) The various methods of carbonizing.
(ii) The economical application of gas for heating purposes.

To carry out the latter, arrangements were made for the establishment of a Fellowship in Gaseous Fuel at the University of Leeds and the association thus begun has since continued to the great advantage of the Gas Industry. Under the fostering care of the Livesey Professor and the direction of a Joint Research Committee, originally called the Gas Investigation Committee, representative of both the University and the Institution, the work has steadily grown in scope and importance.

Besides the non-stop programme at Leeds and in pursuance of the second object of the original programme, other investigations have been carried out in collaboration with various Gas Undertakings concerning the operation of different types of plant and problems arising out of the use of gas and its by-products. A list of the various investigations undertaken since 1906 is appended for reference.

Until recently the problems investigated have been concerned mainly with established practice and include many not mentioned here, but the range is now being extended to include the experimental investigation of new methods of production which may increase the classes of coals which it is now possible to process and provide the means of converting these into gaseous, liquid or solid forms of fuel in any desired proportion. Such a prospect is of more than passing interest, for the Gas Industry is one of several which are concerned with the utilization of the nation's coal resources, and the formulation of a National Fuel Policy which will ensure this being done in the most efficient way is a matter which all fuel technologists and economists who have the nation's interests at heart consider to be long overdue. How it is to be brought about and what form it will take is impossible to say, but it is obvious that the more adaptable, efficient and economic the service the Gas Industry can render, the more important will its position be under the operation of such a policy.

Compared with the amounts now being spent on research by various Research Associations in association with the Department of Scientific and Industrial Research, the amount actually spent through the Institution is comparatively small, but this does not, of course, represent the whole of the expenditure on research within the Gas Industry. It is well known that many of the larger Undertakings and some of the smaller have been engaged in systematic research over a number of years, in the course of which well-equipped laboratories, manned and directed by highly trained research workers, have been established. The fruits of their labours have been freely placed at the disposal of the Industry and the Transactions of the Institution have been enriched from time to time by communications embodying the results of long and expensive investigations.

Then, again, on the contracting side of the Industry, systematic research is being conducted in many well-equipped and efficiently staffed laboratories on matters relating to the production, distribution and utilization of gas and its by-products, whilst the various organizations concerned with the sale of tar, benzole, sulphate of ammonia and coke are also engaged in research work which has for its object the improvement of quality and the extension of the uses of these products.

It is difficult to estimate the total amount thus spent on research for the Gas Industry but Sir David Milne-Watson has informed us that the Gas Light and Coke Company alone is spending £100,000 per annum and, according to the 1937 report of the Society of British Gas Industries, members of that body are spending over £160,000 per annum.

Although, as yet, the Gas Industry has no Research Association the Department of Scientific and Industrial Research is, through its various establishments, engaged in the investigation of problems of vital interest to the Gas Industry both in collaboration with and at the request of the Institution. The reports of these are of the greatest value and the Institution has further been privileged from time to time to receive communications on a wide range of investigations from officials of the Department, not the least interesting of which are those embodying the results of joint investigations between the Department and individual Gas Undertakings.

But, when all is said, it has to be admitted that our research efforts have left much to be desired in respect of both scope and co-ordination. The problem has been engaging the attention of the Council and the Research Executive Committee of the Institution for some time and, on the recommendation of the former, the Council of the British Gas Federation approved of the appointment of a Joint Committee of The Institution of Gas Engineers and the Society of British Gas Industries to consider what might be done. The report of the Committee has been submitted and approved by the Councils of the Institution, the Society and the British Gas Federation respectively, and steps will now be taken to give effect to its recommendations. The main features of these are the appointment of a whole-time Director of Research and the establishment of a Gas Research Board which will, in future, be responsible for co-operative research in the Gas Industry. The Board will be sufficiently representative of the Gas Industry as a whole to satisfy the requirements of the Department of Scientific and Industrial Research if and when it is considered desirable to become so associated with the Department as to qualify for Government grants.

There is no intention of superseding or interfering with the work now being done by individual Undertakings or contractors and, generally speaking, the functions of the new organization will be:

(i) The collection, documentation and distribution of information regarding research work of interest to the Gas Industry.
(ii) The provision of a contact and co-ordinating service between research workers similarly engaged.
(iii) Observation and reporting upon work in progress.
(iv) Planning work for the future and arranging for it to be carried out.

Standardization.

Another of the Industry's major activities is standardization. This may be regarded as a form of research since its aim is the rationalization of experience by observing, collecting, testing and co-ordinating relevant data for a specific purpose. The Standard Specifications for Refractory Materials, Wrought Iron, Meters, Testing of Gas Cookers, and the Standard Conditions of Contract are examples and each is the result of collaboration between the Institution and other interested bodies. Other examples are the Specifications of the British Standards Institution, in the drafting of which the Institution has played its part through the Gas Industry Committee of the British Standards Institution and through members serving on the various technical committees. Much could be said of the uses of standardization and much could be said of its abuses and at the present moment the tendency seems to be rather in the direction of the latter in respect of redundancy and over-elaboration. On the other hand, there can be no question of the value of standardization when this leads to economy and convenience and does not bar the way to progress.

Another special form of standardization is the formulation of model rules suitable for incorporation in national or municipal legislation concerning the fixing, inspecting and operation of plant and appliances. Examples of these, in the drafting of which the Institution has collaborated, are the various rules for the inspection and repair of gasholders, the operation of purifiers, the installation of domestic services and apparatus, the lighting of streets and factories, and procedure for dealing with escapes of gas into Post Office plant.

To these might be added, with advantage, rules for the standardization and certification of appliances in accordance with recognized principles in construction and performance, a measure which is long overdue for the elimination of shoddy, defective and over-rated appliances which are a menace to the user and bring discredit upon the Industry.

Other possibilities in the same direction are suggested by the discussions which have recently taken place regarding the retention and development of the domestic load. As defined by the protagonists, this is a problem which embraces the reasons for the ebb and flow of domestic business, consumer psychology, the design and cost of appliances, consumptions—actual and potential—, the terms of hire and purchase, the nature of the gas tariff, the form of service, training of personnel, and the study of competitors' tactics. If to these be added two other essential factors, namely, the price and the characteristics of the gas produced, we have a problem which concerns all sections of the Industry and, in the solution of which, education and research on all fronts—production, utilization, marketing—are essential. It is a problem, too, which forms a substantial part of the greater problem which confronts the Gas Industry today in respect of its business generally.

The National Organization.

In attempting to speak of the work of the Institution and its relationship to the other national bodies, I have been led to stress the differences in the contribution which each is making and the advantage of the division of labour in securing the best results, but the problem just stated brings us back to the essential unity of all. While it remains true that the Gas Industry has need of the most efficient organizations possible which shall separately, as at present, address themselves to the improvement of the Industry's technique and the training of its personnel, the development and extension of its business and the promotion and safeguarding of its interests, it is equally important and essential that these efforts shall be co-ordinated and directed in accordance with a common policy and that, in the determination and direction of that policy, the Industry shall speak with one voice both to its constituent members within and to the world without.

The formation of the British Gas Federation in 1934 brought together the five principal national organizations and, within certain limits—but not completely—it has fulfilled the requirements of a representative national organization, and it is a matter for regret that recent efforts to improve and strengthen the national organization have not so far accomplished very much. The outstanding feature of each of the national organizations is the voluntary and democratic basis of membership and each has the inherent weaknesses of these characteristics. Policy at any time is liable to reflect compromise and represent the average rather than the best, and the individual member is inclined to make the most of both worlds by claiming full benefit of corporate action while retaining a maximum of freedom for individual and local action. The results are not always compatible with the common interest and this is reflected in the diversity of statutory powers, declared calorific values and the method of charging for gas and appliances, in the attitude towards group purchasing and group marketing and matters of policy generally. It is also reflected in the failure to solve satisfactorily the problem of the smaller units throughout the country and in many other ways.

Compare this indeterminate policy with that of our chief competitor. The electric grid is the last word in national long-distance planning for the wholesale production and distribution of electric power by the most efficient equipment and most up-to-date methods. The McGowan Report outlined further developments on the retail side, including standardization of systems, services and charges, district group control, collective purchasing and publicity and the exploitation of every means of securing new business. Although a certain amount of temporary chaos has resulted from the procedure adopted, all this means intensive competition in the future, and it seems obvious that only by organization on similar lines can the Gas Industry hope to meet such competition with success.

As an Industry, we have recently been privileged "to see ourselves as others see us" through the medium of an unofficial report by P.E.P., which gives a comprehensive survey of the Gas Industry's present activities, enumerates its present weaknesses and prescribes remedies. There will, I think, be general agreement that the first two represent more or less fair comment and, while opinion may differ about the remedies prescribed, they are at least a challenge to the Industry to produce a better prescription if it can and to follow it.

National Service.

One other matter of special interest to members at the present time is National Service. In the early days of the last war there was little attempt made to organize the man power of the country to the best advantage. Happily time was given in which to remedy this, but if a similar situation were to arise today we are warned that it would develop much more rapidly and a greater degree of preparedness is therefore essential.

The Institution, in common with other professional bodies, has been invited by the Ministry of Labour to assist by compiling a register of its members which, in the event of war, would facilitate and expedite the organizing of the technical workers in the country in the most efficient way and with a minimum of dislocation of ordinary business. It is impossible to forecast what may happen in the future, but it is the intention of the authorities, as far as circumstances will permit, to take no one from a reserved occupation without consulting his employer, and members are recommended to fill in and return the registration forms which have been circulated.

A similar state of unpreparedness existed in 1914 in respect of the organization of the Gas Industry's resources, but the Industry responded to the call, and the late Lord Moulton, than whom no one was better qualified to judge, paid tribute thus:

> "No one has had such a unique opportunity of witnessing the response of the Industry to new and exceptional demands made upon it by reason of the war. Your Industry—typically peaceful in character and aims—has furnished material for purely war purposes without which it would have been impossible to maintain the fight. I have thus learnt, as well the flexibility and resourcefulness of the Industry, as the importance to the nation that all its varied capacities should have free scope."

But the lessons of the war were soon forgotten. At no time has the State shown any great concern as to whether the Gas Industry continued to exist or not, and while one

after another of our key industries have become objects of the State's solicitude and fostering care, often to the serious disadvantage of the Gas Industry, the latter has to fend for itself still hampered by the obsolete legislation which Lord Moulton deplored.

Doubtless, however, if the call came, the Gas Industry would respond as before with men and materials, provide munitions of war, make substantial contribution towards rendering the country independent of imported fuel, and "keep the home fires burning".

APPENDIX.

Reports of the Gas Investigation Committee.

No. 1 Part 1 Gas cookers, ring burners, and similar appliances.
„ 2 Lighting with low-pressure burners.
„ 3 Gas fires.
2 Part 1 Tests at the Uddingston Gas Works using 400 B.Th.U. gas.
„ 2 Relative efficiencies in use of different grades of gas (continued from No. 1).
3 Part 1 Relative efficiencies in use of different grades of gas.
„ 2 Relative efficiencies in use of different grades of gas.
4 Efficiencies of processes for manufacturing gas. Tests on continuous vertical retorts at Uddingston.
5 Recording gas calorimeter.
6 Efficiencies of processes for manufacturing gas. Tests on blue water gas installation at the Adderley Street Works, Birmingham.
7 Efficiency of processes for manufacturing gas. Tests on carburetted water gas plant with waste-heat boilers at the Windsor Street Works, Birmingham.
8 Fairweather recording calorimeter.
9 Aeration and air injection of burners. (Part 1).
10 Experiments in the manufacture of blue water gas.
11 Aeration and air injection of burners. (Part 2).
12 Waste-heat boilers on vertical retorts at Birmingham.
13 Part 1 Aeration of lighting burners.
„ 2 Determination of specific gravity of gases. (Special) Standard methods of testing gas ovens.
14 Experimental gas plant at the University of Leeds.
15 Examination of products of combustion from typical gas appliances. (Part 1—Methods of testing.)
16 Studies in carbonization. (Part 1—Influence of the size of coal.)
17 Examination of products of combustion from typical gas appliances. (Part 2—Gas fires.)
18 Studies in carbonization. (Part 2—Size of coal and admixture of inorganic compounds.)
19 Examination of products of combustion from typical gas appliances. (Part 3—Free-burning flames.)
20 Studies in carbonization. (Part 3—Temperature; blending with coke and inorganic compounds.)

Reports of the Joint Research Committee of the Institution of Gas Engineers and Leeds University.

No. 21 Examination of products of combustion from typical gas appliances. (Part IV.)
22 Studies in carbonization. (Part IV.—Influence of various factors on ignition temperature, reactivities, and structure of coke.)
23 Studies in carbonization. (Part V.—Temperature, size of coal, blending with inorganic compounds.) Supplement to 23rd Report. Studies in carbonization. (Part V.—Continued.)
24 Memorandum on the use of creosote in the manufacture of carburetted water gas.
25 Examination of the products of combustion from typical gas appliances. (Part V.)
26 2nd Report on the use of creosote in the manufacture of carburetted water gas.
27 1st Report on the back-run process for the manufacture of carburetted water gas.
28 Examination of the products of combustion from typical gas appliances. (Part VI.—Oxides of nitrogen.)
29 3rd Report on the use of creosote in the manufacture of carburetted water gas.
30 Report on the Sigma B.Th.U. Recorder.
31 2nd Report on the back-run process for the manufacture of carburetted water gas.
32 Test of the intermittent vertical chambers at Croydon.
33 Corrosion from products of combustion of gas—Part I. Preliminary investigation.
34 Corrosion from products of combustion of gas—Part II. Tube experiments.
35 The controlled operation of a carburetted water gas plant—Part I. Factors influencing the performance of the plant.
36 Corrosion from products of combustion of gas—Part III. Tube Experiments (continued).
37 The controlled operation of a carburetted water gas plant—Part II.
38 Corrosion from products of combustion of gas—Part IV. Tube experiments (continued).
39 The Investigation of the use of oxygen and high pressure in complete gasification—Part I. Gasification with oxygen.
40 Combustion Characteristics of town gas—Part I. Review of literature. Part II. Examination of Aeration Test Burner.
41 The Investigation of the use of oxygen and high pressure in gasification—Part II. Synthesis of gaseous hydrocarbons at high pressure.
42 Combustion characteristics of town gas—Part III. Properties and method of use of the Aeration Test Burner (Model A).
43 The Investigation of the use of oxygen and high pressure in gasification—Part III. Synthesis of gaseous hydrocarbons at high pressure.

A Gas Research Board

THE concluding item of the Tuesday afternoon session of the meeting was the presentation by Mr. Harold C. Smith of a report of proposals for the conduct of co-operative research. His remarks were followed by a statement by Mr. E. V. Evans, Chairman of the Research Executive Committee of the Institution.

Mr. Harold C. Smith: The President has asked me to make a report on the proposals for the conduct of co-operative research in the Industry. In the course of the Address which I was privileged to give to you twelve months ago, I said that I believed that we still had much to learn with regard to the processing of coal, the working up of by-products, and the utilization of gas and that more fundamental or long distance research properly directed and carried out on a sufficiently large scale would ultimately pay a handsome dividend.

I expressed the view (a view which I knew was shared by many others) that such research should be carried out in the closest collaboration between gas undertakings and the makers of gas-works plant and gas consuming appliances.

I was able to announce that a definite advance had been made towards the closer collaboration which is so desirable between the gas manufacture and supply side of the Industry and the manufacturers of plant and appliances in the prosecution of long range and fundamental research.

For some time your Council and the Research Executive Committee had had under consideration the possibility of carrying out more work of this nature and had examined means to this end. They had tentatively explored the position as to conditions under which financial assistance might be given to research work by the Department of Scientific and Industrial Research.

As a result of the careful consideration which had been given to the problem and of the conviction that many fundamental and long range problems exist which could with great advantage to the Industry be best examined jointly by both sides of the Industry, your Council had recommended to the Council of the British Gas Federation that the Councils of the Institution and of the Society of British Gas Industries should be invited to appoint a Joint Committee to examine the whole question of the setting up of a research body with the object of conducting research on co-operative lines.

This recommendation had been unanimously approved and it was anticipated that the members appointed to the Joint Committee would shortly meet and commence their discussions.

This Joint Committee was duly constituted and consisted of seven representatives of The Institution of Gas Engineers and seven representatives of the Society of British Gas Industries. Several meetings have been held during the last twelve months and the members of the Committee have had the advantage of studying a Preliminary Survey of Research in the Gas Industry which was made by Dr. W. T. K. Braunholtz shortly after the last Annual Meeting of the Institution.

As a result of their deliberations the Committee recommended to the Councils of The Institution of Gas Engineers and the Society of British Gas Industries that a Research Association to be known as "The Gas Research Board" should be formed having the following objects *inter alia*:

(*a*) To promote and finance research and other scientific work in connexion with the Gas Industry.

(*b*) To establish and maintain a Bureau of Information for the benefit of members of the Board.

(*c*) To encourage the discovery of inventions, improvements, processes, materials, and designs which seem capable of being used by members of the Board.

(*d*) To co-operate with, become a member of, or otherwise assist the research work of any association, institution or other body whose objects include scientific or industrial research in connexion with or of interest to the Gas Industry.

(*e*) If and when considered desirable, to establish and equip laboratories and to pay research workers whether in such laboratories or elsewhere for the conduct of research.

(*f*) To prepare and issue detailed reports for the confidential use of members of the Board.

The recommendations made by the Committee have received the approval of the Council of The Institution of Gas Engineers, the Council of the Society of British Gas Industries, and the Council of the British Gas Federation. The latter Council has asked the Committee to take the necessary steps to set up a Gas Research Board at as early a date as possible.

Any gas undertaking contributing on the full scale to the National funds will automatically become a member of the Board. Firms engaged in the manufacture of gas-works plant and appliances for the use of gas will also be eligible for membership at a rate of subscription to be approved by the Council of the Board. The business of the Board will be managed by a Council, nine members to be nominated by the Council of The Institution of Gas Engineers and six by the Council of the Society of British Gas Industries. The Council of the Board may co-opt not more than five additional members who need not necessarily be members of the Board, exclusive of those who may be nominated by the Department of Scientific and Industrial Research if at any time a financial grant is made by the Department to the Board. The Council may elect its own Chairman.

There will be a President and two Vice-Presidents, one Vice-President to be nominated by the Council of The Institution of Gas Engineers and the other by the Council of the Society of British Gas Industries. Sir David Milne-Watson has consented to become the first President of the Board.

It is considered most essential that there shall be at all times a full time Director of Research or other responsible Technical Officer who will be appointed by the Council and entrusted with the general direction and/or supervision of the research and technical work undertaken by the Board. It is intended that Dr. Braunholtz, as Secretary of the Institution, shall be the first Secretary of the Board.

It is not proposed that the Gas Research Board should at present establish and equip laboratories. The unanimous opinion of the Committee was that the fullest use should be made of existing research facilities in the country and that the various items of work to be done should be farmed out to those organizations best equipped to see the work through. The Director of Research will be expected to keep in touch with all research work which is carried on for the Research Board and also with other work which is being done in the Gas Industry or which is likely to be of interest to the Gas Industry. One of his first duties will be to set up a Bureau of Scientific and Technical Information, the information contained therein being available for the use of all members of the Board.

The Council of the Gas Research Board on its appointment will undertake the direction and supervision of the research work now being carried on by or for The Institution of Gas Engineers. This means that the Gas Research Board will take over the duties of the present Research Executive Committee of the Institution so far as those duties deal with fundamental research. The Chairman of the Research Executive Committee is to speak immediately after me and he will no doubt give you his views on this important change.

It is not intended that an immediate application should be made to the Department of Scientific and Industrial Research for financial aid. The considered opinion of the Committee is that before doing so it would be advisable to give the Research Board a preliminary run to ascertain how effectively the two sides of the Industry can work together on research. Obviously individual undertakings and firms en-

gaged on each side of the Industry (when I say each side I mean on the one hand the gas manufacturing and supply side and on the other hand the makers of gas plant and appliances) may be carrying out items of research which involve the taking out of patents, and it will take a little time for the two sides of the Industry to settle down together and see what items of fundamental research can be done jointly to the ultimate advantage of both sides of the Industry without any interference with the rights or policy of individual undertakings.

The Committee are quite confident that the Gas Research Board will fulfil its objects, but prefer to prove that the success of the Board is assured before asking for a grant from the Department of Scientific and Industrial Research. At the same time a Constitution has been designed, the principles of which the Committee feel would generally be approved by the Department of Scientific and Industrial Research should it be decided at a later date to apply for a grant.

Bearing in mind the possibility of such an application being made the Gas Research Board has been constituted as an autonomous body responsible only to those undertakings and firms who finance it. While the Board will be autonomous, at the same time it has been arranged that the results of such work as the Council of the Board feel may be given publicity shall be discussed at the Autumn Research Meeting of The Institution of Gas Engineers.

I do not think that any persuasion will be necessary to secure your approval for what has been done. The formation of the Gas Research Board has been made possible through the closer collaboration which has taken place between the two sides of the Industry during the past few years. The by-laws of the Institution were altered in 1929, when the Royal Charter was granted, in such a way as to admit to corporate membership technicians engaged in the manufacture of plant and appliances. The formation of the British Gas Federation has brought us closer together. Collaboration on problems of fundamental research can only be for the ultimate good of the Gas Industry.

Unanimous Acceptance.

Mr. E. V. Evans (Chairman of the Research Executive Committee): I welcome the invitation that the President has given me to speak to you upon the necessity of further expanding the scope of research work and of co-ordinating research work in our Industry. But before doing so I should like to express my admiration of the effective and efficient work of Mr. Harold Smith, who, as Chairman of the Ad Hoc Committee appointed to develop our original ideas has so modified and improved those ideas that the scheme to-day receives unanimous acceptance by the various Committees and Councils to which it has had to be submitted. He has also placed before you in a clear and succinct manner the scheme that is now ready to be launched.

During the last decade the amount of research undertaken for the Gas Industry has largely expanded and the need for centralized control and co-ordination has become a pressing one. The formation of a Gas Research Board, with a Director and Bureau, does not therefore constitute a revolutionary change, but is rather a step necessary to maintain orderly procedure in our development.

The Research Executive Committee as to-day constituted consists mainly of men practised in the conduct of research, and their expert knowledge and experience is best utilized when the progress and details of investigations are receiving consideration. It would, in my opinion, be in the best interests of progress if the Council of the Gas Research Board included the majority of those serving on the present Research Executive Committee, together with technicians appointed by the Society of British Gas Industries.

Members of the present Research Committee are busy men, having responsibilities to the undertakings they serve, and although they give much time and thought to the work of the Committee, their task will be much simplified by the appointment of a Director whose main duty will be to co-ordinate and control work in progress.

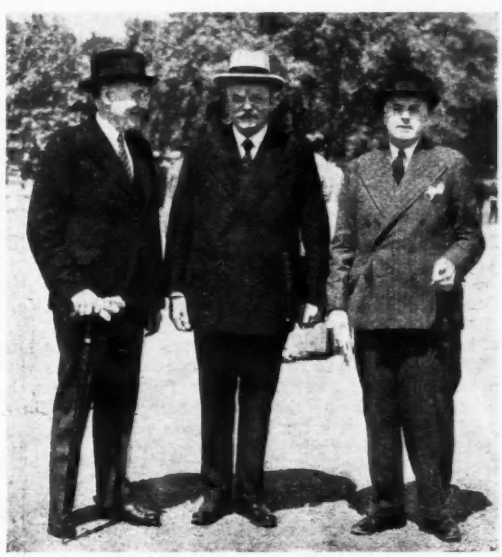
We have given a good deal of thought to the matter of the duties and responsibilities of the Director, and these have been outlined by Mr. H. C. Smith in his statement to you. I should like to say, however, that we are conscious of the fact that the choice of the right man is of supreme importance to the success of the scheme.

You will have appreciated that practically every gas undertaking and the majority of plant and appliance manufacturers will be members of the Board. That there will be available for their use and help a Council, a Director, and a Bureau of Information. Such an organization must, if well administered, have the effect of enhancing the scientific basis of our Industry. We believe that by maintaining a central organization to investigate problems of a fundamental nature, and by ensuring that the new knowledge thus made available is communicated to members, the undertakings and manufacturers will be better placed to carry out investigations themselves with the object of applying the new knowledge to their own special problems. We hope, too, that the offices of the Board may become a central clearing house for those problems which are of too wide a scope to be solved locally, and for observations made in one place that may have a wider sphere of application.

You will appreciate also that the platform of our Autumn Research Meeting will be used for the presentation and discussion of the research work carried out under the guidance of the Board. This, we are sure you will agree, is a matter of considerable value to our Institution. It would be disappointing if our Autumn Meeting were not to become yearly of greater and greater interest and importance to our Industry.

We have good reason to be proud of the work of our investigators and in my opinion we in this country are in the foremost position in our understanding of the scientific principles upon which our Industry is based. Yet I am not so sure that our understanding is so thorough as is the case in certain other basic industries. In building for the future it is our duty to encourage into our Industry not only administrators, but also men of high scientific training. We can only do this provided they feel that their services can be adequately used and their work understood and appreciated. I believe that this fusion of The Institution of Gas Engineers and the Society of British Gas Industries for the purpose of strengthening the scientific basis of our Industry will be a definite step in achieving this desirable end.

The **President:** Having heard from Mr. Smith and Mr. Evans a very clear exposition of the proposals which it is now urged should be gradually put into practice, I am quite certain that any suggestions which members would care to make, either now or preferably in writing, would be very gladly welcomed by the Ad Hoc Committee, of which Mr. Smith is Chairman, and which will carry on the work.



The President with His Successors.

DISCUSSIONS ON THE PAPERS

Summaries and Abstracts of the Papers appeared in our First Institution Number on May 31, and the following are full reports of the Discussions which took place upon them. Papers and Discussions are summarized on earlier pages of this issue in our Review of the Proceedings, which gives the consecutive story of the whole Meeting.

The Test Installation of Static Vertical Retorts at Croydon Gas Works

Communication No. 208

by
WALTER GROGONO, M.I.Mech.E., M.Inst.Gas E.
(Engineer, Croydon Gas Company),
and
T. CAMPBELL FINLAYSON, M.Sc., M.Inst.Gas E., M.I.Chem.E.
(Deputy Technical Director, The Woodall-Duckham Companies, London).

Bournemouth and Croydon.

Mr. William Cash, J.P., F.C.A. (Chairman of the Croydon Gas Company and of the Bournemouth Gas and Water Company): I am not speaking with any technical knowledge, but I have been associated in various capacities with vertical retorts. Mr. Grogono has said that it was 31 years ago when experiments were commenced at Bournemouth. There they began with continuous vertical retorts. Since then I have had the advantage of seeing the work of the intermittent vertical retorts at Croydon. There is now being introduced a plant which a layman might describe as continuous intermittent vertical retorts, but it is labelled with the name "static vertical retorts." In the Oxford Dictionary the word "statical" is described as "concerned with bodies at rest or forces in equilibrium," and "static" is described as "acting as weight but not moving." I do not know whether those two definitions will apply specifically to gas engineers, but I rather doubt it! I am still rather in doubt as to why the retort is called a static retort. The account of the three years' experimental work at Croydon seems to me to provide an extraordinarily good illustration of the co-operation which exists between gas companies and constructors, co-operation which is to the advantage of the gas undertaking and of those who design the plant. It is notable that in the Gas Industry, when anything of that sort takes place, it is possible to publish the results to everybody who may be interested in them. That is not like other branches of commerce, where one undertaking is competing with another. Any advantage which can be gained is made available to our Industry as a whole.

I was Secretary of the Bournemouth Company in 1908, when the matter was first broached, and I became a Director in 1909, so that I have had some experience of the value of continuous vertical retorts. I have had experience in the Croydon Company of the intermittent vertical retort. So far as I am able to judge of the relative advantages of the two systems, they each have advantages which are applicable in special circumstances. My experience of the Croydon installation is that intermittent vertical retorts have done very good work. There is one set there which has worked for 2,500 days and has carbonized more than half a million tons of coal, giving more than 8,000 million cu.ft. of gas, without the ovens having been re-set. The Paper reveals that the experimental plant has carbonized 2,800 tons and has worked for 670 days.

Mr. Grogono has been kind enough to refer to the Chairman and Directors of the Croydon Company. I want to congratulate the Woodall-Duckham Company upon the valuable work they have done, which I hope and believe will result in the prosperity of that particular commercial undertaking. From the point of view of my own Company, I think the money we have spent with them has been very well spent indeed. I congratulate them also on the fact that their static retorts have been erected on the premises of another undertaking in the South of England.

Mr. Grogono is the Engineer at Croydon, where we have the highest admiration for his work and his enthusiasm for the Company, which has led to a like enthusiasm on the part of all those who are working under him.

A Welcome Change.

Mr. S. E. Whitehead (Southampton): While being a research paper, this contribution is a welcome change from the highly theoretical contributions to which we are accustomed, and sets out very clearly the results of work which is of great interest to those of us who are operating or considering intermittent carbonization.

My only excuse for entering into this discussion is where the Authors state that four years have elapsed from the preparation of the first sketch to the putting to work of the first commercial unit, since I was responsible for the unit there referred to. This plant was put to work at Southampton in February of this year and comprises 20 static vertical retorts in a non-recuperative setting, heated by five external producers, and complete with waste-heat boiler and the usual auxiliary plant.

It was hoped that by this date it would have been possible to sectionalize the coal gas stream at the Southampton Works, and that working results would have been available. Owing, however, to the prior claims of A.R.P. and to the fact that certain last-minute modifications were adopted, the new section is not yet completed, and I am therefore unable to give any reliable figures of performance.

The two most striking features of the plant in operation

are first its smooth working in spite of its apparently complicated nature from a mechanical point of view, and secondly the greatly improved cleanliness of the process.

In the discussion upon Mr. F. B. Richards' Paper last year I said, with reference to the intermittent vertical retorts that "the only drawback to the system is that it is a dirty process, and it is pleasing to hear that dust and fumes are being reduced not only at the quenching tower . . . but also in the charging operation."

The improvement then foreshadowed has certainly been attained in the static system. Coke quenching is eliminated, and the dust and smoke nuisance when charging has been reduced to a mere fraction. This abatement of the smoke and dust nuisance was one of the factors which influenced my Company to adopt the new system, but the main reasons were that our experience of intermittent vertical chambers during the preceding six years had been a particularly happy one, and that I had had the advantage and privilege of observing closely the operation of the test retort described in the Paper.

The Paper is so complete that, in the absence of comparative figures, it is difficult to criticize, but there are a few points to which I would like to make reference.

The Authors outline the mechanism of the steaming process and state that the process of steaming is continuous, but it appears to me that this statement may be rather misleading. I am unable at present to say anything on the subject of water gas enrichment, but the actual generation of water gas appears to take the following course: At the commencement of the charge a little blue water gas is made in the coke cooling chamber and ascends into the retort, but as the coke cools fairly rapidly this is of only brief duration. Water gas is then made in the band of coke left in the hot zone and later in the pad which has already been raised to a fairly high temperature. This blue gas rises through the charge of coal and as the latter approaches complete carbonization more water gas is undoubtedly made in the retort itself. The result appears to be that the quantity of water gas made increases throughout the period of the charge, and I think this is borne out from the diagram of gas composition shown in Fig. III.

With regard to calculation of results I cannot quite see the need for correcting all gas results for added air. Surely a "gas as made" figure would be simpler—but I do suggest that correcting to "normal coal" is a needless complication since it involves a definition of "normal" in every case. Would it not be better to work to the "dry ash-free" basis and leave individual engineers to correct the figures to their own particular conditions?

As regards products, the yield of tar appears to be about 5 per cent. higher than that from the same coal in intermittent chambers, and 0·02 lower in specific gravity. The coke produced has, as the Authors suggest, a smaller maximum size, and on the dry basis is about 95 per cent. as dense as that from intermittent vertical chambers, but the character of the coke is sensitive to alterations in cycle, particularly with regard to volatile matter. In that connexion I suggest that the lower ignitability of the coke produced from the longer cycle may be due to the reduction in volatile matter indicated in Table VIII.

In conclusion, I would like also to pay tribute to the design of the commercial plant, especially of the most ingenious charging car and of the extractor driving gear. The static system, by reason of its construction and more complicated mechanical features, necessarily entails higher capital cost and maintenance charges than does the intermittent vertical chamber, and it may well be asked "What do we get in return?" We already have the advantage of greater cleanliness in operation. We obtain a dry coke and a higher tar yield, and I believe we possess (provided one is content to make a gas of lower calorific value) a more flexible unit. But the main "proof of the pudding" must lie in thermal yield, and if this proves to be on the commercial scale as good as that obtained from the Croydon experimental retort, the installation at Southampton will be amply justified.

Unaccounted-for Hydrogen and Carbon.

Mr. E. V. Evans (South Metropolitan): There are two matters in regard to which I should like to comment. Firstly, it is not possible to read this Communication without being struck by the amount of care that has been taken in planning both the installation and the tests made upon it; the determination of yields and the examination of products have been made with commendable thoroughness. The Paper itself is evidence that the team which the Authors led worked with exemplary efficiency and enthusiasm. The Authors state that the plant has been designed in such a manner that it will afford an increased yield of gaseous hydrocarbons, and a close examination of their detailed results supports their contention that the conditions of carbonization are such that hydrocarbons which would otherwise have been degraded into hydrogen and carbon, are conserved. It is evident that the Authors are fully aware of the importance of economic cracking of hydrocarbons in the carbonizing process. This is a matter of great interest to me and was dealt with in a William Young Memorial Lecture in 1928, but the scope of my observations pertained only to the treatment of coal in horizontal retorts. It is fortunate, therefore, that the eleven tests reported in the Paper as having been made with Durham coals were made with such coals that the mean of all the results may be compared with average results obtained in the horizontal retorts of the South Metropolitan Gas Company where a similar mixture of Durham coals is carbonized.

In Table 12 there are shown the volumetric yields of the combustible gaseous constituents obtained during the tests. The comparison is made between the average figure of each column for tests D.1 to D.11 and corresponding figures for horizontal retorts. Carbonization in static verticals gave the following increases over horizontal retorts:

278 cu.ft. more carbon dioxide,
1,842 cu.ft. more carbon monoxide,
785 cu.ft. more hydrogen,
135 cu.ft. more ethane,
42 cu.ft. more unsaturated hydrocarbons,
but 150 cu.ft. *less* methane.

Some of these increases are, of course, due to the reaction of steam with the coke and we may assume that the whole of the extra carbon dioxide and carbon monoxide arose in this way. Each cubic foot of additional carbon dioxide having been formed by the reaction $C + 2H_2O = CO_2 + 2H_2$ gives two cubic feet extra hydrogen, and each cubic foot of carbon monoxide formed by the reaction $C + H_2O = CO + H_2$ corresponds to one cubic foot extra hydrogen. We are then led to expect an increased hydrogen yield of 2 × 278 *plus* 1,842—*i.e.*, 2,398 cu.ft., but we find only 785 cu.ft. The explanation would appear to be that less free hydrogen was formed by thermal decomposition of the hydrocarbons from the coal and we can, in fact, find 415 cu.ft. in the extra ethane and 126 cu.ft. in the extra unsaturated hydrocarbons, though the smaller yield of methane represents the disappearance of a further 300 cu.ft. of hydrogen. The net increase in hydrogen combined as gaseous hydrocarbons is 241 cu.ft., leaving still a deficiency of 1,372 cu.ft. to be sought in the tar and the coke. Now the tar yield also was higher than that from horizontal retorts by 24 lb. per ton and this represents combined hydrogen equivalent to some 278 cu.ft. of free hydrogen. We are still left with hydrogen unaccounted for to the extent of 1,100 cu.ft. per ton and without a knowledge of the hydrogen content of the coke it is impossible to say where this has gone, though I would point out that such a quantity would represent by weight only 0·4 per cent. of the weight of coke.

Confirmation of the view that cracking conditions have been materially less destructive is obtained from a comparison of the distribution of carbon in the products. The outstanding feature is a reduction of 133 lb. in the weight of coke made. Here again it is necessary to make allowance for carbon gasified by the water gas reaction, and this correction can be made by reference to the enhanced yields of carbon dioxide and carbon monoxide, which represent 66 lb. of carbon gasified in this manner. We have then to account for 67 lb. of carbon which was volatilized in the static vertical retorts but would have remained as coke in horizontal retorts. The reduced yield of methane adds 5 lb. to this figure, giving a total of 72 lb., of which 26 lb. appeared as ethane, 21 lb. as additional tar, and 12 lb. as additional unsaturated hydrocarbons, leaving a balance unaccounted for of 13 lb.

Having regard to the yield of tar being greater by 20 per cent. a comparison between the composition of the tar produced in the static vertical test and that obtained from horizontal retorts is also informative, the outstanding feature

of the comparison being the similarity of the two tars. The free carbon content of the horizontal tar is 8·4 per cent. as against 8·1 per cent. from the static verticals. The pitch and oils boiling above 300° C. is 73·8 per cent. against 74·6 per cent. The naphthalene is 4·1 per cent. against 4·7 per cent. The tar acids amount to 4·5 per cent. compared with 3·2 per cent.

The net result of studying the distribution of the hydrogen and carbon of the original coal in the products of carbonization confirms the Authors' claim that a richer yield of volatile products is obtained by carbonization in static vertical retorts than that from carbonization in horizontal retorts. But the full advantage of this richer yield is presumably not realizable without dilution of the gases by the water gas produced in steaming. It is probable, as the Authors suggest, that the passage of the hot water gas through the charge undergoing carbonization gives material assistance in conserving the volatile products.

Results in an Unbiased Light.

Mr. Harold C. Smith (Tottenham): The Paper is of particular value in that the Authors have contented themselves by stating the facts as they see them, without yielding to the temptation of giving estimates of future possibilities of the plant. Every effort has obviously been made to present the results in an unbiased light. While this is so, the basis of comparison of the results obtained on the static vertical retorts and those obtained on intermittent vertical chambers is not, I think, as fair as it might have been. The standard to be obtained in intermittent vertical chambers is that presented to the Institution in 1931. Advances have been made in the construction and operation of intermittent vertical chambers since that date, and I think that more recent results would have provided a more accurate comparison. I was a little surprised to see that the excellent results obtained on the Croydon intermittent vertical chambers were not used for this purpose.

If I might be allowed to give the figures relating to the Tottenham intermittent vertical chamber plant, the average results over the last two years show a production of 80 therms per ton of a calorific value of 541 B.Th.U. per cu.ft. These compare very favourably with the results given in the Paper from intermittent vertical chambers of 77·5 therms per ton of 525 B.Th.U. gas and render the comparison between intermittent vertical chambers and static vertical retorts at the higher calorific values much less favourable to the latter. The coal carbonized over the two year period consisted of 76 per cent. second class Durham washed singles and nuts and 24 per cent. Yorkshire, the whole having an average ash and moisture content of 9·1 per cent.

It is evident from a general review of the Paper that the static plant is not at the momenta competitor of the intermittent vertical chamber plant in the manufacture of gas, having a calorific value above 525 B.Th.U. This is appreciated by the Authors, who point out that unless the static vertical retort can operate at calorific values to permit of internal cooling of the coke by means of steam, intermittent vertical chambers with external quenching of the coke will prove a more economical proposition.

No dimensions are given of the static vertical retort, so that it is not possible to compare the throughput with the throughput of continuous vertical retorts or intermittent vertical chambers. Neither, as is quite understandable, are any costs given or any estimates made of costs of working the plant; but it is the cost per therm produced that matters and not necessarily the number of therms yielded per ton.

At the lower calorific values the static vertical retorts show great advantage over both continuous verticals and intermittent vertical chambers in the production of therms per ton, but until more information is available it is difficult to assess the value of the increased thermal production.

The hydrocarbon enrichment value as shown in Table 9 increases progressively as the calorific value of the gas falls. This applies to all the better class coals and the value comparable with modern intermittent chamber working is only obtained when the calorific value is in the neighbourhood of 460.

The normal hydrocarbon enrichment value of continuous vertical gas is in the neighbourhood of 34. This is easily exceeded on the static plant, the results of which show a substantial advance over continuous vertical working.

I could find no reference in the Paper to the percentage of moisture in the coke discharged from static retorts.

I think the Authors' statements with regard to the sampling of coal and coke might be taken to suggest that to obtain an accurate sample of coal and coke is far easier than it proves to be in actual practice. I do not quite see how accurate sampling of coal is necessarily obtained, because coal to the plant has to first pass through a 3 in. grid and then up a readily accessible inclined belt conveyor on its way to a weighbridge. Similarly, it does not seem to me necessarily to follow that all coke is sampled accurately because the coke has to pass up an inclined drag bar conveyor on its way to the weighbridge skip. These remarks are perhaps hypercritical.

The Authors refer to the practice of allowing air to circulate in the retort to burn off an appreciable proportion of freshly deposited scurf. Since the Tottenham intermittent vertical chamber plant went to work in 1933 it has been our practice to leave each oven open for 17 minutes after discharging. This has been found to burn off scurf quite effectively without necessitating putting ovens out of action for any long period.

Many Technical Attractions.

Mr. E. G. Stewart (Gas Light and Coke Company): This is not the first occasion on which the Institution has been placed in possession of valuable facts relating to the most modern methods of gas manufacture through the efforts of Mr. Grogono and the courtesy of the Croydon Gas Company or by Mr. Finlayson and the Woodall-Duckham Companies, and it may well be that the publication and discussion of this Paper will direct a considerable amount of attention to a form of carbonizing plant which offers many technical attractions. It has been my privilege to inspect the experimental plant at Croydon, which has afforded the occasion for this Paper, and which is, in effect, a complete gas-works equal to (say) an output of 30 millions per annum, and to see the very thorough investigations carried on there. Since I heard that this Paper was to be presented, as may be expected, I have looked forward to it with keen interest.

I was somewhat surprised to read in the Introduction that "the evolution of the Static Vertical Retort may be considered to start with the filing of a patent by Sir Arthur Duckham in June, 1930." Although no Paper was ever published concerning it, the Gas Light and Coke Company had a static vertical retort installation almost identical in principle with the present one in operation in 1929. In 1928 Messrs. West's Gas Improvement Company submitted a design for a static vertical retort to Mr. Hardie, who was sufficiently impressed to recommend the Gas Light and Coke Company to install a trial unit of eight 100-in. retorts with a carbonizing capacity of 50 tons per day—a size of unit which could be considered equal to a full-sized plant. The plant was installed and started at the Company's Shoreditch Works in 1929, and continued in operation until 1933, when for reasons quite unconnected with the installation the Works was completely closed down for gas-making purposes and dismantled. The West vertical plant, however, was left intact, in case gas-making should ever be resumed at the station, and is still standing to-day.

Results at Shoreditch.

During the course of the four years very complete tests were made, under the supervision of Dr. Hollings and the then Engineer, Mr. Moys, and I have examined our records and compared them with the results given in the present Paper. It is gratifying to find that our own results and those here published are almost identical. In the last twelve months of its working the installation operated without interruption, carbonizing 16,500 tons of coal. The calorific value averaged 532 B.Th.U. for one month and was normally between 525 and 530 B.Th.U. The hydrocarbon enrichment value was somewhat in excess of those shown in Table 9 at 39.

While I welcome the results given by the Authors, which they have set out with commendable clarity, I feel that they could have been more complete. In fact, it is in the omissions and not the contents that I feel a little disappointment in this Paper. I would have liked to know the dimensions of the test retort, the temperature gradient in the heating

flues and in the retort, while a thermal balance would have been of great value. Further, I cannot understand the Authors' modesty in sending their coke samples to an outside source for test, as I am sure that we should all have been willing to have accepted any tests that they have made as impartial, and if standard C.A.B. tests, porosity, and reactivity tests have in fact been made by them, it would be interesting to know the results.

The question of coke characteristics is to-day becoming a vital factor in the choice of carbonizing plant in many localities.

In their introduction the Authors set out the three considerations which this test plant was to prove. Of these, information has really only been given in respect of the last. Surely to members of this Institution the advantage of this method of carbonization over existing types is of the highest importance, and some indication of the Authors' assessment of (1) and (2) would be valuable.

We know that the design sets out to combine the closed circuit carbonization, the cool coke discharge and continuous steaming of the continuous vertical retorts with the high thermal yield of the intermittent vertical, and it would appear from the Paper that complete success has been achieved without operating difficulties.

Considerable flexibility in calorific value is also indicated. On the other hand, there is said to be an upper limit of calorific value which might be disadvantageous to undertakings operating with a declared value of 500 B.Th.U. and adopting benzole and sulphur reduction plants. Is this the total price to be paid for the advantages mentioned, or have we to face in addition higher capital and operating costs? Are the retorts harder to repair and to scurf? Is there any limiting swelling value of the coal which can be used? What is the effect of sticking charges as the retorts get old, and how are they dealt with in view of the closed lower end? I cannot but feel that the Authors must have by now definite views on these and pertinent matters, which would be of the utmost value to all of us when we are faced with the choice of new carbonizing plant. I know that it can be said that the Paper really only sets out to describe three years' experimental work, and, of course, it succeeds in so doing, but this has only served to whet our appetites for information concerning the broader and more commercial considerations. These tests naturally cannot give information concerning fuel consumption, so I would ask if the Authors have information from any other source to indicate if this is likely to be higher than usual on account of the requirements of the water gas reaction.

The design of static retort here presented seems to me elegant in its conception, and for that reason I am constrained to ask whether the somewhat clumsy device of inserting a cold coke pad before charging is likely to be a permanent feature. Its use presumably arises from the high efficiency of the coke extractor which lowers the charge so gently, even too gently, and leaves it intact, so causing an annulus in consequence of the retort taper, which would get filled with small coal.

St. Albans Plant.

Mr. T. C. Battersby (Watford and St. Albans): Early in 1934 my Company found it necessary to increase the carbonizing plant at their St. Albans Station, and in reviewing the different carbonizing processes then available we were especially attracted by a system where a static charge is continuously steamed during carbonization. Mr. Stewart has mentioned that the first commercial installation of this system was installed by the Gas Light and Coke Company at their Shoreditch Station, but at the time of our investigation this Works was closed down, and the only installation of this type supplying the requirements of a town was at Tilburg in Holland. After investigating these results a series of tests were conducted on the Research Plant at Manchester, using the particular coals we carbonize at St. Albans. The results indicated that the process offered all the advantages of vertical intermittent carbonization with the cleanliness of the continuous system, and in August, 1934, my Company decided to install a West vertical plant of 3½ million cu.ft. per day. The system has already been described in the Technical Press on several occasions, and I do not propose to deal with the design here except to say that the chief differences between the West and Woodall-Duckham chambers lie in the methods of charging the coal and discharging the cooled coke.

I should like to know if the 10 minutes which are allowed before charging are sufficient to keep the chamber clear of scurf; or is it necessary to empty the chamber completely at intervals for the removal of carbon? I suppose this period is also sufficient to heat the cold coke pad and so prevent excessive bottom pressures when the chamber is first charged.

As to the results obtained on the Croydon Research Plant, the Authors have given figures which I consider can be maintained in commercial practice. It might be interesting as a supplement to the figures we have been given to compare the yields we have obtained on the St. Albans plant, which has carbonized over 160,000 tons of coal. In these figures I shall give you the thermal yield corrected to N.T.P., and full allowance has been made for fresh gas oil added to the benzole washers. The declared value is 500.

During March—85·13 therms per ton, including 2·95 gallons crude benzole.

During April—85·38 therms per ton, including 2·45 gallons of benzole.

During May—83·84 therms per ton, including 3 gallons of benzole.

I have allowed 1½ therms/gall. of benzole.

The tar yield averaged 13·3 gallons per ton and during the period 15,000 tons of coal were treated, with an ash content of 4·1 per cent. and moisture 3·8 per cent.

Generally speaking, our information regarding the gas and by-products which are produced is in agreement with the findings recorded in the Paper. As to the coke, we have no comparable information, but our sales experience shows that chamber coke is well received.

I feel that it is to the benefit of the Industry that others are pursuing and developing this process. At St. Albans we have had practical difficulties which were not revealed on the test plant, but most of them have been overcome. The returns from the process indicate a low production cost per therm, which must be the aim and object of every development, and while operating costs are low, we have yet to obtain a reliable figure for repairs and maintenance, and it will be appreciated this can only be determined after extended operation. At the St. Albans Works we produce 3 million cu.ft. per day, and from 5 p.m. to 7.30 a.m. we have on the Works five men and one foreman.

An Expression of Appreciation.

Mr. F. B. Richards (London): It is not my intention to trespass in any way on the preserves of the Authors of this Paper or to attempt replies to questions which have been asked by other speakers, although possibly in other circumstances I might have been tempted to do so. I should like, however, to use this opportunity of expressing appreciation, both on my own behalf and on behalf of the Woodall-Duckham Company, for the facilities accorded us at Croydon by the Chairman and Directors of the Croydon Gas Company—facilities which have made possible the work which the Authors of the Paper have described. Without the collaboration of the operating side of the Industry, constructors of plant could not do very much. Without that co-operation they must perforce forego the opportunity of translating their thoughts into deeds, their ideas into practice, and it is very good for the Industry that both sides should collaborate in the way that has been described.

No doubt many of you have at some time or other tried to develop a new idea, to bring some pet theory of yours into practical form. No doubt many of you also have spent some of your leisure moments in the garden. Those who have done those two things will appreciate that, however good the seed may be, one of the vital matters affecting plant growth or the successful development of ideas is the atmosphere in which they are tried out. The soil must be favourable, the climate must be genial, there must be nourishment and there must be water and sunshine. All those things we have found at Croydon in Mr. Grogono, who is so well known to you.

Many years ago it was my good fortune to be given the opportunity by Col. Woodall, whom I am pleased to see here to-day, of taking part with him and his colleague, the late Sir Arthur Duckham, in the development of the Woodall-Duckham continuous vertical retort. The day on which Col. Woodall gave me that opportunity was one of the happiest

and most fortunate in my life. In that development work we went through many and bitter tribulations, but we survived. In the development of the static vertical at Croydon we have been spared, by good fortune no doubt, many of the trials and tribulations that we experienced in the development of the continuous vertical. Possibly during the intervening time we have tried to profit a little by the experiences of our earlier days, and the experience we gained in the development of the continuous vertical has no doubt contributed largely to, as we hope, the promising development of what may prove in some measure to be its successor.

The commercial results cannot even be speculated upon, of course. The process must be tried out; and fortunately again for the Gas Industry and for the constructors, two gentlemen who are here to-day have had the courage to recommend their Boards of Directors to install commercial plants on this system. They are Mr. Whitehead, of Southampton, and Mr. Hunter Rioch, of Cambridge. I should like to express appreciation of the courage of those two gentlemen, and I sincerely hope that that courage will not be misplaced. If that should be the case, however, it will not be the fault of the constructors, it will be their misfortune.

Results of Shoreditch Plant.

Mr. H. Moys (Gas Light and Coke Company): I read this Paper with interest and also with a little astonishment. My reason for taking part in the discussion is that when Station Engineer of the Shoreditch Works, under my control there was what I considered to be a static vertical retort plant. This plant was first put to work in 1929. The Paper states that the evolution of the static vertical retort system may be considered to start with the filing of a patent by Sir Arthur Duckham in June, 1930. Apparently five years were allowed to elapse before the system was seriously considered by the patentees.

The Shoreditch plant consisted of eight 100 in. retorts, and was capable of making 840,000 cu.ft. per day. The plant described in the Paper had only one retort, and consequently the most important factor—namely, coke used for fuel in the producers—could not be ascertained. It would, however, have been of interest if some figure could have been given, and possibly from the experience gained from the Shoreditch plant it might have been possible to assess this at somewhere near its proper value.

When tests are made of installations the most important factor is to obtain a thermal balance of the process, and reading through the Paper I cannot find mention of temperatures in any part of the plant. Knowing the process, I consider it very necessary to have the figures for the temperature of the outlet gas and also for the temperature of the waste gases.

The tests (covering a period of one month) made on the Shoreditch plant were confined to different qualities of Durham coal delivered during the period to the Shoreditch Works. This coal was run-of-mine coal, and loaded from ships into barges and then transferred to Shoreditch. The month's test was made by our Chemical Department on the installation, and a thermal balance was obtained and also the residual products were thoroughly examined both for quantity and quality. During this period the coals used were:

25 per cent. Silksworth,
21 per cent. Wearmouth,
38 per cent. Horden,
16 per cent. Lambton,

with an average inert constituent of 9·2 per cent.

The average calorific value for the purified gas was 513·6 B.Th.U. per cu.ft. The yield of gas was 84·28 therms per ton on a basis of 8 per cent. inerts in the coal. The tar made (free of water) was eleven gallons to the ton. It will be seen that these compare with the figures stated in the Paper, and in a way confirm the results.

The Authors have attempted to explain why a high yield of therms per ton of coal is obtained with the static vertical retort over other systems, but it is problematical and ambiguous.

There is a difference in design between the plant at Shoreditch and Croydon. I was privileged to see the latter plant, and it was apparent that attempts had been made to overcome some supposed difficulties with the Shoreditch plant. In some cases it might appear that there were certain improvements and in others the reverse. I would particularly refer to the use of breeze pads. I think the Shoreditch plant has a distinct advantage in this matter, as no breeze pad is required.

There was one particular result of the plant which always impressed me, and that was the quality of the coke, which in my view was at least equal to if not superior to that ordinarily made in horizontals, intermittent verticals, or continuous verticals.

When the plant was working at Shoreditch all the makes of gas figures were corrected to 500 B.Th.U. This always seemed to me the proper way, so that any advantage or disadvantage in making a low or high calorific gas was then made apparent. In the Paper the statement is made that if the calorific value falls, this advantage—*e.g.*, high thermal yield—of the static vertical retort increases. Would this have been the case if the figures were corrected back to 500 B.Th.U.? The Shoreditch plant worked very economically at 520 B.Th.U., and this figure allowed for benzole extraction.

I have always been an admirer of this interesting and fascinating system of carbonization, and I have no doubt that as time goes on we shall hear a great deal more about it.

A Stable and Hard-Wearing Plant.

Mr. H. H. Brown (Exeter): Having had the opportunity of inspecting the complete test installation at Croydon early in 1937 and having been associated with Mr. Carey in carrying out some of the tests on Durham run-of-mine coals, I have looked forward to the presentation of this Paper with considerable interest. The three objects which the test plant was designed to determine may have been realized, but the Paper deals almost exclusively with objects (I) and (III). That no serious or unsurmountable difficulty in construction had been encountered may be assumed from the functioning of the Southampton installation, but I suggest that some information regarding object (II) might have been of interest, even if given with reserve. The distinctive feature of the plant—namely, the coke cooling chamber—might have been expected to present difficulties to the designer, but the selection of suitable materials combined with imagination in design have resulted in what appears to be a particularly stable and hard-wearing unit. The characteristics of two of the products, coke and tar, could not have been very fully covered without enlarging the Paper considerably, but I am sure that members would welcome information on one or two points not covered. The properties of static vertical coke are said to lie between those of continuous and intermittent coke, and this is in part borne out by the tests given in Tables 6, 7 and 8, but there are serious difficulties in co-relating the properties of cokes from the various systems without elaborating more fully the actual test conditions. This follows from the variations in the proportion of twice heated coke in the total coke yield.

It is the practice in some undertakings where continuous verticals are used to separate twice heated coke (following scurfing) from normal coke, so that a fuel of uniform combustion characteristics may be marketed. The difficulty with static vertical coke is that the twice heated coke (including the pad coke) cannot be separated. Do not the Authors consider that the once heated coke would have quite different characteristics (especially regarding ignition reactivity) from those of the twice heated coke? One would also like to have information regarding the technique of sampling the coke designed to ensure truly representative samples.

Injection of Tar.

I would suggest that the advent of static verticals presents a possibility of reducing the yield of tar and modifying its characteristics. At the present time when the tar market is weak the urge to explore a new technique should be less casual. Could not a controlled amount of tar be injected into the top of the chamber remote from the gas offtake during the extra steaming period with some prospect of further cracking, thereby increasing the gas yield? The subsequent steaming of the blackened coke in the middle zone of the chamber might ensure increased reactivity in water gas production and yield a grey coke. No other carbonizing system offers the possibility presented here.

It was not possible to forecast fuel consumption from the

testing of a single unit, but because the greater part of the sensible heat of the coke in the cooling chamber heated is dissipated by radiation, etc., and, because the length of chamber heated is greater in terms of coal charge depth, the fuel consumption is not likely to be less than that experienced in Intermittent Retort practice. Do the Authors consider that the internal heating of the steaming charge goes far to offset this extra heat expenditure?

The design of the gas treatment and sampling plant was such that great reliance could properly be placed on the test results obtained, and there seems little doubt that considerable increase in the gaseous therms could be obtained, especially if the calorific value of the gas was controlled to be less than 500 B.Th.U. That the increased thermal yield is not only due to blue gas, but to an increase in the amount of non-condensable hydrocarbons, is one of the advantages claimed for the process.

The most important constructional feature of the static installation ensures freedom from the quenching nuisance. If it can be shown on the commercial plant that the improved value of the products more than offsets the increased capital and maintenance charges then the development in design of the static system will have been fully justified.

(Further written contributions were invited, and the Authors intimated that they would reply in writing to the discussion.)

Distribution and Sales Organization

Communication No. 209

by

NOEL S. SMITH, Assoc.M.Inst.Gas E.

(Distribution Engineer and Sales Manager, Bristol Gas Company).

Mr. R. J. Rogers (Parkinson Stove Company): The impression that is left with one after reading this Paper is one of admiration for the lucid manner in which Mr. Noel Smith has outlined the systematic organization of the Distribution and Sales Department of the Bristol Gas Company. The organization which Mr. Smith has defined is a comparatively new one, as he points out that in 1932 a drastic alteration in methods affecting the Distribution and Sales Department was recommended by the Secretary and Commercial Manager and the Engineer and Works Manager in order to strengthen the Company's efforts to meet intensified competition. In many directions, therefore, it may be considered to be a model system for an up-to-date distribution and sales organization. The growth of competition with which the Bristol organization has had to contend is indicated by a study of Tables 11a and 11b, which show that whereas in one of the older districts the ratio of gas to electric cookers is as 16 to 1, in a district with more than the average of *new* property the ratio of gas to electric cookers is only 8·5 to 1.

A warning which should be taken very seriously is contained in Mr. Smith's statement that "it is well to remember that in future the domestic business will be shared and the lion's share will go to the most enterprising competitor." The realization of this position led the Joint Gas Conference in Birmingham and the British Commercial Gas Association in Brighton to give prominent attention to the question of the retention and development of the domestic load.

It is heartening to hear from Mr. Smith that, apart from lighting, there has been a definite increase during the past twelve months in the reclamation of business for gas which had been previously lost to electricity, and there can be no doubt that this recovery has only been achieved by the intensive sales effort carried out by the organization which has been so clearly laid out in the Paper.

In connexion with the type of service pipes used, Mr. Smith states that since 1922 wrought iron or mild steel tubes have been used for services in place of lead pipes in troughs which was the former practice. As the services in Bristol to-day consist of 50 per cent. of lead pipes and 50 per cent. wrought iron or mild steel tube, it would be interesting if Mr. Smith would tell us, as a result of his close personal experience on this subject, that he is entirely satisfied that the policy of discontinuing the use of lead services has been fully justified.

Effects of Gas Drying.

Table 2, which shows the effect of the installation of dehydrating plant, is most interesting, and the installation of dehydrating plant has undoubtedly led to increased service to the consumer by reason of the fewer complaints regarding water in services, meters, and consumers' fittings. It would appear there has been a reduction of approximately 75 per cent. in the number of such complaints since the dehydrating plants were installed.

I am glad to know that Mr. Smith has emphasized the importance which his Department attaches to the early contact with architects and builders regarding new property. Provided the right type of personnel is employed to contact with the architect and builder, I can confirm from my own experience that expenditure of money for such work is fully justified.

Bristol has, for many years, been rather unique in the large number of instantaneous and other water heaters installed, and it is interesting to note that of installations in new houses in 1938, 91·1 per cent. had water heating appliances installed, these being mainly of the instantaneous type; only 5 per cent. of this total were wash boilers. On the other hand, the applications for gas for space heating purposes in new houses still equals only 7·5 per cent., indicating that there are enormous potentialities for the use of gaseous heating in domestic premises. It is interesting to contemplate the reason for the comparatively low percentage of new premises adopting gaseous heating to-day.

The figure of 7·5 per cent. given by Mr. Smith for Bristol is indicative of the position in most large cities to-day. The type of gas appliances now available, coupled with the price of gas used in such apparatus, are, in my opinion, the principal factors which manufacturers of appliances and gas undertakings have to consider in developing the further use of gas for space heating in domestic premises.

Fitting Section.

The particulars which Mr. Smith has given regarding the detailed working of the Fittings Section at Bristol will, I am sure, be reviewed with very considerable interest by those in charge of Fittings Departments of other undertakings, particularly with regard to the grading of fitters, average appliance fitting costs, number of complaints, and escapes attended to.

I gather from the Paper that the whole of the fitters working in the Bristol area operate from the main Fittings Depôt. The amount of tram and 'bus fares paid to the Fitting Section during 1938 is given, but I shall be interested to know if Mr. Smith has regular analysis of the cost of walking and travelling time as a percentage of the working time of the fitters in his various districts. With the development of housing areas which are in many towns situated a considerable distance from the central depôt, it has been found, in many Undertakings, to be beneficial to arrange district fittings depôts in order to increase the effective working time of fitters on consumers' premises and to save the cost of walking and travelling time.

The statistics given regarding the cost of transport will also be exceptionally useful for reference purposes by other undertakings. Mr. Smith gives the mileage cost of the various transport used, and I should be interested to know if he has

information regarding the cost of delivery per article by the different types of vehicle.

While in many cities, for various reasons, such as greater expedition, motor-operated vehicles have replaced horse-drawn vehicles, it has been found in some areas that, on a point of cost per article delivered, horse-drawn vehicles have proved more economical, particularly for operation within short distances from the stores depôts, and it would be useful to know if Mr. Smith has any comparative figures with regard to transport by the two methods.

Sales Department.

The growth of sales in Bristol, which is indicated in the Paper, has undoubtedly been very largely assisted by the magnificent showrooms of the Company situated at "Radiant House." Through the courtesy of the Bristol Gas Company, members of the Institution will have an opportunity of visiting these fine showrooms on Friday next, and will appreciate the point made by Mr. Smith that "what was five years ago a display room at the Head Office is now a head office at the showrooms." The attractiveness of the displays and the flexibility of their settings reflects the utmost credit on all concerned, and the sales value of the building must be appreciated when we hear that it is not unusual for 1,800 people to enter the showroom in a single day.

In addition to the central showroom the Bristol Gas Company's policy has been to arrange displays in the windows of ironmongers and other traders; in no fewer than 47 premises the Gas Company have opportunities for making window displays of gas appliances, and the co-operation of the ironmongers and plumbers has been obtained in the sale of gas appliances. In my opinion there has been altogether too much apathy on the part of many undertakings in enlisting the co-operation and assistance of allied traders in various towns in displaying and selling gas appliances, and whereas the electrical and many other industries have fostered this co-operation for some years past, it is, in many towns, only within comparatively recent years that this co-operation has been sought by gas undertakings. There have been notable exceptions to this, however, and in Birmingham for the past 35 years ironmongers and traders have acted as contractors to the Department, and their premises have been utilized for the display of appliances and also for the collection of gas accounts in certain districts.

Notwithstanding the many advantages which accrue from collaboration with ironmongers and other traders it is, I think, desirable in large areas that the sole display or representation should not be left entirely with such traders, but the gas undertaking would find that district showrooms, with their own gas undertaking personnel in charge, would materially support the efforts of the outside traders. It must be remembered that the trader's co-operation can only be obtained by the undertaking if it is made a financial proposition to himself, and beyond the financial interest, in many cases he may not be greatly concerned. It is, therefore, necessary, if the utmost service is to be rendered to the consumers in the whole of an undertaking's area, that the gas undertaking's influence, by its direct representatives or its showrooms, should be exerted in addition to the efforts of the traders.

An Efficient Gas Engine.

Col. W. M. Carr, O.B.E., T.D. (United Kingdom Gas Corporation): I am constrained to take part in this discussion largely by reason of a footnote in the industrial and commercial section of the Paper. There it is stated that "oil is still a formidable competitor in large installations, particularly for central heating, metal melting, and bread baking, while electricity, having almost entirely displaced the gas engine, is making a strong bid for a further share of the industrial load." During the last two years I have been extremely interested in the possibilities of producing a gas engine that would be at least as efficient as a diesel engine, and as a result of investigations that have been carried out by numerous investigators it is certain to-day that gas at a price round about 6d. per therm (or 2s. 6d. per 1,000 cu.ft. where the calorific value is 500 B.Th.U. per cu.ft.) can be used for power purposes, not only to compete with electricity at standard rates, but to compete with the diesel engine. In fact, only last week I witnessed the tests of an ordinary 200 h.p. diesel engine which was running on town gas with the addition of 7 per cent. of fuel oil for the purpose of ignition, the efficiency being approximately 7,000 B.Th.U. per b.h.p. hour. That efficiency was well maintained under varying load, and therefore it is a fact that the high compression engine can be operated satisfactorily on town gas. That same engine, I believe, would be equally satisfactory if operated with electrical ignition and 100 per cent. town gas. One of the difficulties has been to find sparking plugs which will withstand the very high pressures which are set up in the diesel type of engine. It has been done, however, in various aeroplane engines, where the pressures are as high as, and in some instances higher than, the normal diesel pressures. Therefore, it does appear that now is the time when we must concentrate on seeking to recover this very important load. In another engine of the aero type we have obtained even higher efficiencies than were possible with the diesel engine. At the moment it has only been operated in comparatively small units; but when I tell you that a 10-h.p. engine running perfectly from no load to maximum load is operating at an efficiency of 6,700 B.Th.U. per b.h.p. hour with town gas, which is equivalent to approximately 13½ cu.ft. per hour, you will appreciate the possibilities of this development.

Again, its extension to road transport becomes immediately practicable. There, unfortunately, owing to the exigencies of national demands, we know that it is impossible to acquire the cylinders which are necessary for holding compressed gas for road transport purposes. It is very unfortunate that that circumstance should arise at a time when the nation wants gas for road transport purposes more than ever it did, because oil supplies such as are available to-day for industrial and transport purposes cannot possibly be available in time of war, having regard to the mechanization of the Army and the enormous demands of the Air Force. Although I may have digressed a little from the immediate point of the Paper, I do feel that the time has come when we must all make a strong bid for a further share of the industrial load.

The Author has dealt with the excellent organization which is set up by his Company, and he points out that a maintenance service which does not safeguard the consumer against rising consumption for no just cause is incomplete and unlikely to retain business. That remark is indeed most true when it is applied to industrial considerations, and we have very often lost industrial load because we have not in many undertakings been able to set up a maintenance service which safeguarded the industrial user against rises in consumption or which made available to the industrial consumer immediately the advantage of any improvement that could be effected in the appliances he might be using. Therefore, it is abundantly clear that not only is that remark by the Author most cogent so far as the domestic load is concerned, but even more so in respect of the industrial load.

With regard to the very interesting classification of the industrial and commercial consumption which is given in the Paper, I would like to ask the Author whether a definite survey was made of the appliances of the whole of the users, or whether it was compiled simply from the general knowledge of the business, because one often finds that in an engineering works, for example, proportions of the gas requirements are taken for purposes other than the actual furnace or other industrial applications.

Experience at Swindon.

Mr. C. H. Chester (Swindon United Gas Company): In laying before the Institution for the first time a complete plan of distribution with details of the tie-up of its many ramifications, Mr. Smith has openly shown up past weaknesses in organization, which competition made plain, but which his Company quite properly and quickly corrected, thus justifying the system. Mr. Smith expressed the view that probably as a near neighbour our experiences might be somewhat similar, but they are far from it. In the first place, the Bristol Company has a relatively small area of 30 square miles for the output with such a density of population (470,000) that only 659 miles of mains are required to supply 122,640 consumers, or an average consumption per consumer of 32,000 cu.ft. a year. Moreover, with a large percentage of well-paid artisans—mainly because of tobacco and aeroplane manufacture—the potential sale of gas per consumer is bound to

be higher than in our case, particularly as those industries will use gas in process work giving both a better load, and load factor, per head of population. Swindon's case is different in this respect. An area of over 500 square miles (mostly rural) has a population of under 100,000 and requires 230 miles of mains. Apart from about 60,000, the population is mostly agricultural—and badly paid. The 60,000 are mostly dependent on the Railway Works, which make their own gas, thus leaving in the town itself little industrial development and rather difficult domestic business. The position is made worse by the fact that rail workers' privileges allow the purchase of coal at the exceptionally low figure of 1s. 5d. per cwt. which, being a long way from coal fields, is probably unique. Yet our consumption per consumer is rising in competition with coal where the latter is being purchased at the proper price.

In my opinion, no review of a distribution and sales organization can be complete without a preview of the possibilities and difficulties of the district. So few cases are identical that it is perhaps fatally costly to copy; yet with a proper system and appreciation of the possibilities much energy and money can be saved. With these facts before me development has been planned. Central heating, domestic rural lighting (where current is expensive), minor industrial load, such as hoteliers, restaurateurs, with tariffs designed to make gas more competitive against coal for fires and water heating, have all proved successful; and I find a domestic tariff down to at least 4½d. per therm is necessary. Have Bristol considered a tariff? In calculating a tariff one will always arrive at the conclusion that revenue will be lost; but in practice the tariff has to be sold, and if properly sold against coal for fires, water heating, etc., it will pay every time. That is our experience—in fact, in seven years our load has been doubled and will be trebled within the next three years. Yet the rate of profit per therm of gas sold drops only slightly—2·3d. to 2·0d.

I have already said how difficult it is to sell gas against cheap coal in the south. I gave away over 2,000 gas fires in twelve months in a special campaign to popularize gas heating. The gas fire load has never looked back—in fact, our gas output this year is up 25 per cent. due to the cold early spring and largely increased numbers of cookers, water heaters, and boilers. The last item, wash-boilers, receives insufficient attention. Seven years ago Swindon's peak day was Sunday, due to cooking; Monday being cold meat day was the minimum. Now, with the greater use of gas wash-boilers, Monday is by 10 per cent. our maximum day.

I congratulate the Bristol Gas Company on the success of their Estate development costs. Until a few years ago we had similar help; but with Corporation Electricity competing strongly—and that free of cost—we now have to do the work free, and we lay duplicate mains in nearly every case. Future maintenance of services with a corrosive sub-soil will, I think, repay this; but as a bargaining factor, as with builders and tenants, it has removed an irksome selling point.

Black Cookers Must Go.

All must agree that black cookers must go—and the sooner the better. While purchase or hire purchase develops pride in ownership and makes gas cooking more secure, I cannot help thinking the Industry would do better in some areas if a little less profit was *asked* for on new appliances. I said "asked" advisedly knowing that sales are sadly affected. In seven years our profit on appliances has been so low that a loss one year nearly equalled it; yet no one can say we have not reaped the benefit in gas sales. I am in agreement with the general publicity and sales organization presented to us by Mr. Smith, but will the Author express an opinion on maintenance and its relation to gas quality and consumer satisfaction—particularly in relation to sulphur? If we really get to know what consumers think of dirty water heaters, discoloured baths, walls, etc., due to copper sulphate, then we shall all soon remove sulphur.

Has Mr. Smith tried internal staff sales competitions? They are a tonic. I would like Mr. Smith to state more precisely what he means by adjusting works pressures. Does he mean increasing the high-pressure feeder pressures or on low-pressure main? If the latter, has he considered the effect on meters, unaccounted-for gas, and the unfortunate consumer near the works? In seven years we have reduced peak load pressure from 15 in. to 8 in. and so contributed to a drop of 8 per cent. in unaccounted-for gas—and that at a time when the peak has nearly doubled. Does not Mr. Smith attribute the low number of "heating" applications to the absence of a gas tariff compared with a keen electrical tariff? One credit to lower price gas for heating is that it coincides with coke make and demand—not an inconsiderable figure.

The public lighting prospects are, I am afraid, similar in most towns with Corporation electricity and Company gas; but Mr. Smith's point regarding out-districts where such a bias does not exist and where competition is open, coincides with mine and is a point of interest for our publicity department at National Headquarters.

I am at a loss to understand the Table relating to meters exchanged. If my calculations are correct, it looks as if meters have an average life of nearly 85 years. Is this building up heavy renewal in the future or is some other renewal method adopted not shown in the Paper? I feel that every meter requires a test after seven years. Mr. Smith describes transport control and cost. I should have thought that since the contractor must make profit, it would have been more profitable in such a large Undertaking to own one's own fleet. I am glad Mr. Smith mentioned emergency calls, as I feel nothing is more irritating to a consumer than to have difficulty in making contact with a public utility serving him every hour of the day and night. The Industry could profitably copy the Home Service Section of the Bristol Company, and I am pleased to see the womenfolk taking a hand in what is, after all, a woman's job. Efficiency in manufacture and distribution is lost if our system does not take the consumer into calculation. Mr. Smith has indicated how this can be done, and is to be congratulated on boldly and clearly outlining the Bristol organization.

Applications for Gas.

Mr. W. M. Paterson (Brighton): It would appear that a new consumer in Bristol is first contacted by a uniformed collector or inspector. Surely the man to do this should be a salesman. The prospective consumer is certain to be giving a great deal of thought to the arrangements in his new home, and a salesman would approach him in a manner entirely different from that of an inspector who calls merely to measure up and get a form signed.

I have never been convinced that it is worth while to test pipes on delivery. A pipe sound in the yard may be damaged on delivery to the job, and in the long run you are dependent on the mainlaying ganger "ringing" the pipes before laying. I would be interested to know the cost per yard of the tests carried out at Bristol, and also the figures of faults found. Then again, the total length of new services laid must be almost as much as the length of new mains; yet only 1 per cent. of service pipes are tested on delivery. I have heard it suggested that a rejected and returned consignment is promptly despatched by the makers to another purchaser who is known to accept goods without test, but I think that suggestion is more facetious than factual.

The question of transport by contract was discussed in Brighton a year or two ago, when some of our fleet were due for scrapping, but it was decided that if a contractor could make a profit by handling our goods, we ought to be able to do the work ourselves at lower cost. It would appear from the costs given that our decision was a correct one. Our costs are compiled in detail for each van, and inclusion is made for tyre replacement, repairs and maintenance, taxes, etc., and depreciation. For the year 1938 the all-in costs per van averaged 28s. per day, or 7d. per mile. These figures include the wages of a driver and mate on each van, and the types of van in use are somewhat similar to those at Bristol, ranging from 40 cwt. to 15 cwt. capacity. Hired transport is used occasionally during busy periods, but we are satisfied that privately owned transport is best.

In the reference Mr. Smith makes to canvassing, he indicates that he has an open mind as to the method of finding additional canvassers. It is my opinion that the sales staff should be in the employment, and under the direct control, of the undertaking. An outside sales agency was most useful to us as a stop-gap until we had chosen additional salesmen

from our own clerical and technical staffs and had made certain internal rearrangements to release them for training; but the engagement of the agency was never looked upon as permanent. It is possible that better results would be obtained by giving technical training to an outsider with selling ability than by trying to create a salesman out of a gasfitter, but we have found that our best salesmen started with the Company as fitters' mates. The advantage of having the right type of man to interview consumers outweighs the disadvantage of having to make a second call by a fittings foreman to measure up and make out a requisition for materials. The use of a schedule of fixing charges enables the salesman to clinch an order on the spot, and in a great many cases he is able to indicate the materials required without the need of another call. In principle, however, we consider that the special functions of a salesman are so different from the technical requirements of gasfitting that we should not be restricted in our choice solely to men with gasfitting experience. Our policy is to have one salesman responsible for all consumer contact in his territory, covering on an average 2,500 consumers per man. Part of his duties are canvassing selected consumers during special appliance sales campaigns. We hope that in time each man will be known and asked for by name by a large number of the consumers in his district.

The commendable co-operation with other public utilities in Bristol has been carried a step further in the A.R.P. scheme. It is my own opinion that repair squads should be combined as at Bristol into units capable of dealing with either gas, water, or electricity repairs, and we are trying to work out a similar scheme at Brighton. Normal work will cease in time of war, and it will be most wasteful if the public utilities have each to keep a large body of men standing by for emergency. It is highly probable that all services would be affected at the same point, and repairs could probably be carried out more quickly by one squad of labourers under proper direction than by three separate squads all trying to work in a restricted space. We are all having to meet the same problems on A.R.P. work and it would be most useful if an opportunity could be given to pool ideas. Am I, Mr. President, very much out of order in suggesting a private discussion at the Autumn Meeting?

(Further contributions in writing were invited, and Mr. Noel Smith was asked to reply to the discussion in writing.)

Non-Ferrous Metals and the Gas Industry

by

HAROLD MOORE, C.B.E., D.Sc.
(Director),

and

E. A. G. LIDDIARD, M.A.
(Assistant Research Superintendent, British Non-Ferrous Metals Research Association).

Communication No. 210

Mr. S. F. Dunkley (Gas Light and Coke Company): For many years manufacturers and research workers in the Gas Industry have been seeking for new materials and processes to enable them to overcome various difficulties encountered in the manufacture, installation, and maintenance of the very large variety of appliances and materials which we handle.

I assume that owing to the wide scope of the Paper the Authors have considered it inadvisable to dwell on the many hundreds of ferrous and non-ferrous alloys in use to-day. Most of these modern alloys have been developed for one particular purpose or set of conditions, and the Engineer finds it difficult to make use of them for two reasons. First, owing to the data being specialized it is incomplete regarding their general mechanical, chemical, and physical properties, and secondly, the difficulty of reference owing to the absence of any suitably tabulated and summarized list. I fully realize the difficulties of anticipating all industrial requirements, but should like to ask Dr. Moore whether he has considered the preparation of a National Standard List of alloys indexed under properties rather than trade names.

As the Authors hint, expense is always a major factor and the cost of non-ferrous metals in comparison with iron and steel is a point which will often preclude their use. In many cases it would be difficult to obtain the strength and rigidity of steel without increasing the gauge of metal to an extent such as to render the cost prohibitive. Other points often militating against the adoption of non-ferrous metals are their very unstable market prices and the fact that in many cases they cannot be mined in England.

Copper is a case in point, and if its price, which has been fluctuating between £30 and £78 per ton over the last ten years, could be stabilized, this metal would be used more extensively.

Modern Methods of Fabrication.

The Authors refer to modern methods of fabrication. The Gas Industry has not been slow in taking advantage of these, and indeed, was one of the first to adopt on a large scale hot pressed brass stampings. These have been generally adopted to-day wherever practicable, and have not only overcome the difficult problem of porosity associated with castings but at the same time produced a much stronger article of reduced bulk and section.

Die castings have been adopted to some extent but the low melting point, hardness, and tensile strength of suitable alloys has restricted their use. As soon as research workers have succeeded in producing sound die castings in brass, this form of fabrication will be more widely used.

I should be interested to hear from the Authors as to whether work is in progress to improve the properties of sintered alloys such as carbo or porous bronzes, as this method of fabrication would seem to show promise in the development of self lubricating metals for use with taps and valves. Up to the moment their low tensile strength, porosity and manufacturing difficulties have made their adoption for such purposes inadvisable.

One point in favour of non-ferrous metals which might be stressed is that of coiled tubing. The ease with which lead, copper, and certain alloys can be coiled renders transport and stocking simple, and enables long runs to be installed with the minimum number of joints. The degree of hardness needs to be controlled, as the pipe is liable to flatten during storage.

Non-ferrous tubes also have a smoother internal surface than those of welded steel, and hence it is possible to reduce the bore without affecting the pressure loss.

The Authors discuss the question of corrosion. By far the most important of these are soil and water corrosion, and corrosion due to the products of combustion. Although it is common practice to deposit electrically a coating of some non-ferrous metal on iron or steel as a protection against corrosion, I have found from experience that one cannot be sure of a continuous protective film unless the surface is completely polished to cause a flowing of the metal. This may be possibly inconvenient and expensive, but cannot safely be neglected.

Use of Stainless and Heat-Resisting Steels.

Actually I feel that in the Gas Industry there is a growing tendency towards replacing certain non-ferrous metals by stainless and heat resisting steels. The calorized iron grill fret for example, mentioned in the Paper, is being abandoned in favour of a heat resisting steel.

In many cases a more efficient coating can be obtained by means of non-metallic substances. Service pipes, for example, are coated with pitch and bitumenized hessian. Such a coat-

ing makes it possible for us to retain the strength of iron with its low cost, and yet employ an electrically insulated protection thick enough to withstand maltreatment and damage from sharp stones.

In the case of appliances and flue pipes which are exposed to heat, products of combustion, and domestic kitchen conditions, vitreous enamel is employed as a protection. I would venture to suggest many electro-deposited non-ferrous coats of normal thickness would fail under the combined action of fruit juices, abrasion, blows, etc., that the average vitreous enamelled cooker withstands.

With regard to the removal of sulphur compounds from gas at the works, the Authors no doubt are aware that the Gas Light and Coke Company, for instance, has been steadily reducing the sulphur content of its gas during recent years. The methods available were described in the Paper given by Hollings, Hutchison, and Griffith, to the Institution last year. Removal of sulphur is not only of importance in preventing corrosion but also in allowing expansion of gas sales for flueless heating. Until such time, however, as the manufacturing side of the Industry can give us gas free from sulphur, no effort should be spared to find cheap materials or coatings to prevent the type of corrosion which so frequently causes a decline in the performance of certain appliances and considerably increases district maintenance costs.

The Authors make some mention of the use of aluminium as a reflector in gas fires. I should like to point out that it is no longer used to any extent, as there is too great a tendency for the polished surface to become scratched. However, it will be interesting to have some information regarding the blackening of tea in aluminium kettles. This appears to be due to iron present as an impurity in the aluminium, but does not occur with iron kettles.

Season Cracking of Brass.

I notice that reference is made to the question of season cracking of brass. Although a temperature of 250°-300° C. is sufficient to relieve internal stresses in the fabricated metal as received, further cold working, such as bending a tube to shape or slight twisting due to screwing is likely to replace such stresses and leave the tube still liable to crack in service. High tensile strength is not required, but rather softness and bendability, and therefore brass tubes need to be fully annealed to leave a considerable margin of safety for any subsequent and reasonable amount of cold working. In this respect it should be borne in mind that tubes containing tin of the order of 1-1·5 per cent. are more prone when cold worked to season cracking than when tin is absent.

The Authors mention the use of nickel chrome alloys for fire radiants. This is a field to which considerable thought has been devoted, but I should like to add that use of nickel chrome has been rather limited as the refractory radiant has proved far more satisfactory in price, life, and appearance. I believe that the ideal alloy is known, but that there is some difficulty in fabricating into wire. The subject is important, and any help that could be given in this direction would be appreciated.

No doubt all these problems are receiving consideration and perhaps the Authors have the solutions already well in hand.

In conclusion, I should like to pay tribute to B.N.F.R.A. for all the help they have given and are giving to the Gas Industry, and I can assure Dr. Moore that if there is at any time a dearth of problems for him to tackle he can always rely on the Gas Industry to present him with some new ones.

Use of Non-Ferrous Metals in Holland.

Professor G. A. Brender à Brandis, of Holland (Vice-President, International Gas Union): We in our country are very much interested in the use of non-ferrous metals, because we are anxious to ensure safety and especially safety for the consumer. Therefore, I have read the Paper with very great interest. I should like to put two questions. In the first place, in Section VI the Authors refer to the use of copper for service pipes. A copper pipe will be more expensive than an iron or steel pipe, of course, but I should like to ask if there is not a danger of bi-metallic corrosion in the connexion between copper and iron. If you connect a copper pipe at one end to the gas main and at the other end to the meter, it seems that there might be a possibility of bi-metallic corrosion, and I should be very interested to have any information on this matter from the Authors.

In the same section of the Paper the Authors refer to the use of lead composition for connecting meters, gas water heaters, etc. In our country we do not allow the use of lead for the connexion of geysers and water heaters. We do use lead for connexions to meters, but for connexions to water heaters, geysers, etc., we have to use iron or copper, and nowadays we use a good deal of aluminium. In that respect, perhaps, we are unduly careful, and it may be that for short distances we could use lead, which is so easy to work. Do you use lead for connecting geysers and water heaters in this country, and do the Authors consider that we are too severe in prohibiting the use of lead for connexions to such appliances?

Copper Pipes in American Practice.

Mr. F. Latimer (I.C.I.): A year or so ago, when I was in America, I was fortunate enough to receive an invitation from the President of the American Gas Association to attend a Conference of the A.G.A. Distribution Engineers at Cincinnati. The problem of gas distribution in non-ferrous metals was fully discussed there. Among the matters in the Paper now before us which stand out for particular attention there is the reference to the use of copper tubes in America. Nearly all those engineers whom I met there were unanimous in stating that copper in general was proving a salvation to them, more for underground distribution than for internal carcassing, etc. The A.G.A. Standards Committee permits the use of copper for three purposes: (1) Underground servicing from the street mains to the meters; (2) internal carcassing; and (3) appliance connexions. The use of copper tubes for connexions to water heaters, etc., is quite common practice in this country and in America. We recognize, of course, that soil corrosion is a very complex problem, and that point was discussed fully at the American Conference. But most of the speakers at that Conference felt that, while they might pay initially a little more for the use of copper tubes than for tubes in other materials, they were safeguarded in being relatively free from trouble, not only trouble to themselves, but also trouble to the consumers.

I was fortunate enough to see one particular application of copper tubes—namely, for replacing old iron tubes underground without removing the iron tubes. The practice was adopted of using a long soft tempered copper coil, upwards of 75 ft. in continuous lengths; after digging a hole at the pavement end of the service and cleaning out the bore of the iron tube, they pushed the copper tube through that bore to the house connexion, and it was then pulled through and connected to the meter. Thus the old iron service continued to serve as a protection for the copper, and the copper was expected to last for quite a considerable time.

With regard to the internal corrosion of copper pipes, American engineers found that they were not seriously troubled with sulphur; but where the sulphur content was considered to be in the danger zone they adopted the use of tinned copper pipes—*i.e.*, copper pipes having a coating of pure tin—and they found them to be quite satisfactory. The engineers issued a warning, however, regarding the use of aluminium tubes, particularly for appliance connexions. They found that in a number of instances where aluminium tubes were used for connecting gas water heaters, cookers, and the like the cleaning materials commonly used by the housewife, such as soda and soap, attacked the aluminium, and the latter had to be replaced by copper or lead.

I feel that the remarks made in the Paper regarding the cost of copper pipes need a little explanation. Speaking as a manufacturer of copper tubes, I can say we have found that in general the material cost of the copper tube is admittedly greater than that of iron, and as one speaker has said, we are up against the problem of fluctuations in price. But when one takes into consideration the saving of labour in laying the services and the freedom from trouble thereafter, the use of copper has a very strong appeal. One important gas engineer in this country carried out a practical test in 24 houses, half of which were serviced with iron pipes, and the other

half with copper pipes. The ultimate cost (the material and labour cost) was in favour of iron to the extent of about 1s. per house.

The Authors refer to the use of lead pipes in soft tempered coils. As I have already mentioned, it is quite common practice in the copper industry to supply copper tubes in soft tempered coils in long lengths, thus reducing the number of joints, making the material more convenient to handle, and saving labour costs.

As we all know, copper tubes are being used extensively in this country for water services, and they have been used for upwards of about a century. In many instances those copper tubes are used underground for conveying water, but chiefly they are used internally, of course, for connexions from the rising mains to the tanks and for distribution in the house. I see no reason why copper tubes should not be used for the distribution of gas. While little or very little trouble has been experienced with copper tubes, used in connexion with ferrous materials, admittedly where certain classes of water are used one does meet trouble. But I think that with gas one can feel a certain degree of assurance that copper does offer a very strong appeal to take its place with lead and iron for distribution purposes.

Resistance to Marine Conditions.

Mr. G. A. Andrew (British Aluminium Company): The Authors state that aluminium is remarkably resistant to atmospheric corrosion in all but marine atmospheres. I think that, without explanation, that presents rather a gloomy picture of the position. Undoubtedly in the past there have been unfortunate experiences under marine conditions, but definitely it has been established that those experiences were much more due to the use of unsuitable types of aluminium alloy rather than to anything inherent. There is no doubt that high purity aluminium, and the aluminium-magnesium alloys in particular, have a very high resistance to marine conditions, and it is perhaps worth mentioning that aluminium-magnesium alloys are now approved by the Board of Trade for lifeboat construction. In addition, there are methods available for providing increased protection, such as by coating the surfaces of aluminium alloys with high-purity aluminium, thus providing not only mechanical protection but also electrolytic protection, or by anodizing, which is probably the most effective way of protecting aluminium alloys used under marine conditions. In that connexion the use of the new brightened and protected aluminium reflectors, which are anodized, is worth mentioning. Tests both in this country and in America have given extremely good results under marine conditions. In fact, in America they go as far as to say that these new reflectors are, if anything, more stable under marine conditions than under industrial conditions. The great secret of getting a really good performance out of these reflectors is to keep them reasonably clean. If they are open reflectors they ought not to be allowed to become coated with a continuous coating of dirt, which will absorb acids and moisture. To obtain the best results it is necessary for them to be cleaned little but regularly.

Another matter of interest is the use of aluminium alloys for die-cast gas burners. I believe they are used extensively in America, and also to some extent in France. The advantages claimed are that die-casting gives uniform ports in the burner, and therefore an even distribution of gas. Other important materials, which perhaps are not ordinarily thought of in connexion with aluminium, are the aluminium-containing materials; I do not mean aluminium-rich alloys, but materials containing up to about 10 per cent. of aluminium. These have very useful properties for gas engineers in two directions. Aluminium brasses and bronzes are definitely more resistant to acids, and I think that aluminium bronze has been used successfully in burners and other parts. It is also possible to make very strong and dense die-castings in aluminium bronze, using a special technique. A speaker has said that bronze or brass die-castings would be useful. The use of aluminium in heat-resisting materials is interesting. Aluminium containing cast iron, or possibly aluminium-steels, is in course of development and certainly has excellent resistance to heat, and, I think, a very remarkable resistance to sulphur products.

Inter-Relation of Applied Science.

Mr. C. H. Carder (Director, Cold Rolled Brass and Copper Association): It is as a colleague of some 25 years' experience in the Gas Industry rather than in my new capacity that I speak to the members of the Institution. In his Address yesterday, the President referred to the fact that every branch of applied science is to-day inter-related to every other branch, and that a discovery in one may be of value in another. This is well exemplified by the Paper before us. Research work is constantly in progress in investigating the causes of failure and in devising improved methods of production and in the specialized development of some individual feature so as to render a metal increasingly suitable for some particular use, and in the production of alloys to extend still further the range of their usefulness. All this is of great value in providing us with materials to satisfy an ever-widening range of application. I am a member of one Committee of the British Non-Ferrous Metals Research Association, and I know the care and thoroughness with which their work is conducted.

I was particularly interested in the Authors' reference to the extent to which copper service pipe is being used in the United States, where soil conditions are particularly bad. That is common practice in Australia. Copper water service pipes are used compulsorily throughout the whole of the Sydney area at least, and I believe in other parts of Australia as well. Another direction in which the relative costs of copper and iron pipes are well worth looking into is in connexion with internal carcassing work. Copper pipe in diameters from about ½ in. up to more than 1 in. can now be obtained in continuous lengths of up to about 70-75 ft., as has already been mentioned. I will not waste time by reiterating the advantages which the copper pipe offers, partly because of the smaller bore which can be used for passing equal gas quantities owing to the smoothness of the bore, and the convenience which that offers, particularly in re-carcassing old buildings to meet modern requirements of gas appliance installations. It is possible with long lengths of copper pipe to draw the pipe through, instead of having to take up, cut, and piece in.

Dr. Moore has in hand some research on the use and development of an alloy for high-temperature work. We have certain cases where steam is being used at very high pressures, such as from 650 to 800 lb. per sq.in., and that involves a substantial temperature; in other cases, around our retort installations, materials have to withstand long exposure to high temperatures and often under conditions which subject them to severe vibration, so that failure by fatigue or by change in the crystal structure, as well as failure by creep, is not unknown. In that direction we can only hope that Dr. Moore's researches will be successful. My last point concerns the connexion of appliances, and more particularly industrial appliances. I am referring to the advantages of the use of aluminium foil as an insulating material in the case of polished aluminium sheets. It gives heat insulation and an economy of heating capacity which is well worth investigating in minor furnaces and even major furnace installations, and it enables us to reduce substantially the weight of construction and to increase economy.

Development of Ternary Alloys.

Mr. Brindly-Jones: Speaking on behalf of a Company which is actively concerned with the development of lead and lead alloys, I can endorse many of the statements made in the section dealing with this subject. As Dr. Moore has said, the advantages of lead are accompanied by certain weaknesses, such as low resistance to fatigue, and the weaknesses have necessitated research work which has resulted in improved properties in many directions. The development of ternary alloys containing cadmium and tin by the British Non-Ferrous Metals Research Association, and later the addition of tin to lead, have both been extremely helpful in avoiding troubles due to intercrystalline breakdown where fluctuating stresses are encountered in service.

It might be permissible in connexion with the Gas Industry to refer to the extensive use of lead in the frequently associated manufacture of sulphuric acid, and subsequently of ammonium sulphate. Lead is used for chambers, towers, ammonia saturators, heating and cooling coils, and the like,

and in this sphere the manufacturer is accustomed to the demand for large quantities of lead with a purity exceeding 99·99 per cent. Where such purity is expected, the research worker is particularly handicapped, perhaps unnecessarily handicapped, by the low strength of lead, referred to by Dr. Moore as its debit side. Highly pure lead is extremely weak. Even so, recent work tends to show that quite considerable improvements in the mechanical properties of lead can be brought about while still retaining a minimum lead content of 99·99 per cent. The reference made by the Authors to the future use of pipes of considerably greater hardness than pure lead is important, and I think it can be said that the Research Association and other laboratories have such possibilities under constant review.

Softness of Lead an Advantage.

Mr. Winser: I should like to draw attention to the softness of lead as one of its advantages, to the ease with which it can be placed in position, and to its resistance to corrosion. A pipe made of such material would seem to have some definite advantages for such things as service pipes between the main and the meter. I believe that an objection to its use in the old days was the risk of the effect of condensing gas; but I believe that nowadays the risk of condensing gas is very small, and it might be worth while considering a return to earlier practice. We are not concerned so much now with the cost of the pipe as with the cost of opening a road and inspecting a service; the cost of reinstatement of road surfaces is a very serious matter, and a small additional initial expense on a pipe which is relatively free from corrosion and which can be laid around obstacles easily may prove to be a considerable economy. Naturally, the ease of placing lead pipe into position applies equally to internal carcassing.

Undue Optimism.

Mr. T. G. Noble (Gas Light and Coke Company): I must confess to feeling some disappointment at the Authors' outline of some of the uses of the non-ferrous metals in our Industry, since within a brief compass they make a number of statements which, to say the least, are unduly optimistic and which in one or two cases are misleading if not wholly inaccurate. I wish to draw attention only to some points affecting water heating appliances, since it is with these appliances that I am most familiar, and it is in them that corrosion is met in some of its most troublesome forms. To begin with, the Authors, while apparently implying their agreement with the hoary fallacy that condensation necessarily occurs on surfaces below 100° C., show little if any recognition of the basic differences between the operating conditions of the two types of heaters known as "condensing" and "non-condensing." For example, while aluminium sprayed on to copper or steel has distinct advantages in non-condensing appliances, it is inferior in condensing types, not because of the weight but because of the voluminous nature of the corrosion deposit; it may even, in these circumstances, be more objectionable than unprotected copper.

In general, I feel they adopt a remarkably complacent attitude to one of the major problems of the Industry. Thus we find the somewhat surprising statement that "copper has good resistance to corrosion," and the further comment that copper heating tubes, bodies, etc., are "tinned to protect the copper from the action of the sulphurous gases." I can only conclude that neither of the Authors enjoys the many undoubted advantages of an instantaneous gas hot water system, and hope that in their reply they will be able to give us some hints on the protection of the cast iron mostly employed for the heating units of the excellent alternative gas-fired storage or circulating water heaters which I presume they must be using, or suggestions as to possible substitute materials.

I should like to ask the Authors' views on the relative merits of tin applied electrolytically and by the hot wiping method as a protective coating for copper exposed to products of combustion and also to the alkaline and oxidizing solutions commonly employed for laundry purposes. Their faith in both tin and lead as protective coatings for copper water heaters is much greater than my own. They tell us that "Tin is resistant to condensed products of combustion even when sulphur is present," that "with lead the product of corrosion is the practically insoluble lead sulphate which therefore forms a film protective against further attack," and conclude that "those parts of water heating appliances, etc., exposed to the products of gas combustion should be coated with an adequate thickness of tin, lead, or tin-lead solder." I suppose we must concede that academically an "adequate" thickness of these non-ferrous metals would be sufficient! But how remote this all seems from our everyday experience of heaters "protected" by just these methods.

This air of unreality pervades the references to water heating appliances. Thus we learn that the "high thermal conductivity of copper . . . is an advantage" and that "galvanized iron is *not fully resistant* (!) to atmospheres high in sulphur dioxide, particularly when condensation is also liable to occur." I can assure the Authors that they need rarely worry about the thermal conductivity so far as the thermal efficiency of the heater is concerned, if only they can help us to overcome corrosion, and that to state that galvanized iron is "not fully resistant" under the conditions specified is distinctly optimistic!

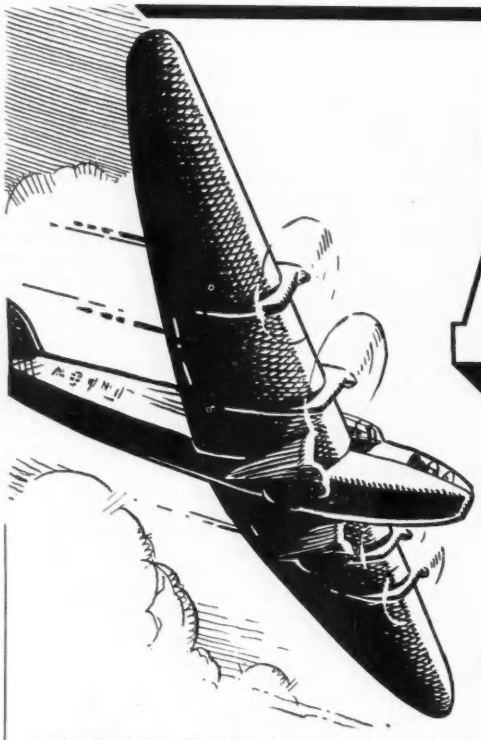
The general impression one receives is that the Authors are thinking of corrosion in terms of academic tests on the loss of weight or degree of penetration of metals and their effect on the life of appliances, etc. These aspects are, of course, important, but, broadly speaking, they are not to-day the main interest of the Industry. We object to corrosion of water heaters primarily because a corroded flue-way may ultimately become a source of danger, because the corrosion products lead to complaints from customers—*e.g.*, of wall or ceiling staining—because they put up our maintenance costs and restrict possibilities in design. At Watson House where we have developed a very satisfactory form of life test for water heaters, we have been trying various non-ferrous and non-metallic finishes with a degree of success which I cannot claim to be altogether reassuring to date but which is very promising. I think that the Authors may better be able to assist us, together with other workers in this field, including certain manufacturers, if they realize that the problem has much more to it than their Paper suggests. I hope that they will accept my criticisms as necessary steps towards this end and not as a complaint that they have no immediate solutions of our many complicated problems.

The Authors' Reply.

Mr. Liddiard, replying to the discussion, said: There will not be time to deal with all the points which have been raised. But many of the speakers have made remarks which are in amplification of the Paper, so that I will not refer further to them. The remarks of Mr. Dunkley and Mr. Noble were particularly appreciated, and I think the Gas Industry is extremely fortunate in having people who look after its interests so well. Mr. Dunkley is very friendly to us, and he gives us quite a lot of trouble in getting out information for him, which he uses for the benefit of the Gas Industry. We very much appreciate the contact which has been made through the Gas Industry and through our own particular organization.

The unstable market price of copper is a matter about which I, as a technical man, cannot say very much; but I know that my ignorance is no greater than that of many on the Stock Exchange at the time when the enormous variations took place! However, there is no reason, from the technical point of view, why there should be any variation, because there are enormous reserves of copper, and the cost of production of copper is such that there is no good reason for any violent price fluctuation. I do not see why it should occur again.

We were asked by Professor Brender à Brandis whether bi-metallic corrosion might occur in an installation where copper is used in contact with other metal. In the case of water services I think that is possible, and we have mentioned that point in the Paper. But the trouble is less likely to occur in ordinary atmospheric conditions, and I think that rather too much emphasis has been laid on the problem of bi-metallic corrosion so far as atmospheric corrosion is concerned. If there is a copper tube in a system where water does not pass over the copper and into some bath of galvanized or possibly bare iron, I do not think there is likely to be trouble. Again, if a water is non-aggressive—and a great many waters are non-aggressive—there is not likely to be trouble. There are many cases in which a bi-metallic form



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of construction can be used perfectly successfully, though it must be admitted that there are cases in which failure occurs. In answer to the second question put by Professor Brender à Brandis, I cannot see any reason why the use of lead should not be allowed in the connexion of gas heating appliances.

I cannot help thinking that the only difference between the attitude of Mr. Noble and ourselves is a question of the comparative standards we take. If we say that a material is not fully resistant, and if Mr. Noble says that that material is not resistant at all, it is merely a question of the standards of resistance we are applying. I think he was quite right to say that the Paper was perhaps a little optimistic; but he must appreciate our point. We are not here to point out the defects of non-ferrous metals, though we have done so, I think, fairly firmly. On the other hand, if we were to point out the difficulties and defects in the production and handling of gas, I am sure that that would not be appreciated by the Institution. There is no doubt that gas, particularly when it contains traces of sulphur, is a particularly difficult material to handle without running the risk of serious corrosion. Perhaps that has not been sufficiently emphasized in the Paper. But I think that, given co-operation between the Gas Industry and the metallurgical industry generally, it should be possible to overcome even that serious difficulty.

Comfort by Gas Heating

Communication No. 211

by

L. W. ANDREW, B.A., B.Sc., M.Inst.Gas E.

and

A. BARRON

(Gas Light and Coke Company)

Sir Leonard Hill, F.R.S.: A point mentioned in the Paper to which I would like particularly to draw your attention is that of the quality of radiation. That is a matter to which the Gas Industry has not hitherto given as much attention as it should. The quality of radiation is most important in our country. If on a sunny day you enter a greenhouse which is heated only by the sun, and where the door has been closed previously, you feel quite oppressed by the horribly stuffy nature of the atmosphere. That is due entirely to the quality of the radiation and to nothing else. Again, if on a frosty day you enter a railway carriage which previously has been empty, but is heated, the windows having been closed, you also feel that the atmosphere is horribly stuffy, and you want to open the windows in order to enable the air to blow through the carriage. That again is due to the quality of the radiation. The long infra-red rays which come from dark sources of heat, and in great excess also from dull red sources of heat, cannot penetrate the skin; they are caught by the surface of the skin, so that the skin is heated and the heat is conducted inwards. If you come from a cool outdoor atmosphere, with your skin cold, and if you are then subjected to heat from rather an intense source, you experience an unpleasant, dry, tight kind of feeling, due to the heating of the surface of the skin by the long rays.

On the other hand, the short infra-red rays, shorter than 1-2μ, and red rays, penetrate the skin. The other visible rays, in addition to the red, also penetrate and are absorbed by the blood in the multitude of capillaries running in the derma. But the red rays penetrate somewhat deeper, though not very deep; they are gradually absorbed and they heat the subcutaneous tissue. If you wish to prove that the red rays do penetrate, you can go into a dark room and hold a lighted electric glow lamp in the mouth, and you will see a dull light through the cheek, which is about 5 mm. thick. So that a dull red glow does penetrate through 5 mm. The penetrating rays keep the skin healthy. I have discovered that the penetrating and non-penetrating rays have remarkably different effects. The non-penetrating rays, which heat the surface reflexly, excite a dilatation of the blood vessels in the air passages of the nose and the lungs, and that dilatation produces what might be called a stuffy effect in the air passages of the nose, the sinuses of the nose, and the air passages of the lungs. There is a narrowing of the airways of the nose and lungs. The short penetrating rays, however, have the opposite effect. They do not excite this dilatation and narrowing of the air passages. I have discovered that one set of rays antagonizes the other set of rays. The rays from a dull red electric fire will reflexly excite the dilatation of the blood vessels in the airways, narrowing the airways. But if you switch on a bright source, such as a little arc lamp, for example, the rays from that source antagonize and set aside the reflex effect. Cold air will do the same; moving cool air acting upon the skin will immediately antagonize the narrowing effect in the nose passages.

I published these facts some years ago, and they were denied, because those who had denied them did not imitate the experiments I made. But recently G. Lehmann, a German, has not only confirmed my results, but has gone further. He not only agrees with my results concerning what he calls ill nasal reflexes, but he has also shown that the non-penetrating rays, acting upon an area of skin, provoke reflexly vasa-dilatation of other skin areas, reflexly congesting other skin areas, whereas short infra-red rays and red rays have the converse effect, producing vasa-constriction of other skin areas. There is a kind of compensating cooling effect. The explanation is that there is a certain natural fall of temperature from within outwards in the skin. Naturally, if the skin is exposed in the open air, the deeper parts of the skin are warmer than is the surface, and there is a temperature gradient downwards from within outwards. The long non-penetrating rays reverse the position, heating the surface, so that the surface becomes hotter than the deeper parts of the skin. That leads to discomfort, the reflex dilatation and the stuffy effect on the airways, and so on. The penetrating rays make the depth of the skin still warmer than the surface.

The penetration of these rays was proved by a Danish physiologist some years ago and by Dr. Harold Hartley at the laboratories of Radiation Ltd. Dr. Hartley has shown you how the modern gas fires have been improved by increasing their brightness, thus increasing the amount of penetrating rays in proportion to the non-penetrating rays, increasing comfort. The dark firebrick which used to be exposed above the luminous rays is eliminated; it was the dark firebrick which gave off what I call the unpleasant rays. The luminous bright sources give off pleasant rays. The flaming coal fire is pleasant because of the quality of the flaming rays. The dull red and dark sources, such as steam pipes, radiators, and the like, are unpleasant because they give nothing but non-penetrating rays which heat the surface of the skin.

I think you have great scope in getting the public to realize that the quality of the rays is of great importance, and that the aim of the makers of gas fires has been to increase the luminosity, so improving the quality of the rays and the comfort they afford.

Design of Radiants.

Dr. Harold Hartley (Radiation Ltd.): For some years now the need has been felt for fundamental modification in the gas fire—for an alteration greater than mere change of fashion. It is over 30 years since the columnar radiant emerged, and, for the most part, since that date gas fires have been characterized by vertical radiants of skeletal form, the radiant embracing in most cases only one flame, although in a few designs two or more flames have been enclosed by one radiant.

Prior to the introduction of the columnar radiant, some gas fires were of the ball fuel type, and others were designed to imitate coke fires, but since that period general development requirements have, for the most part, been subordinated

to technical needs. Up to about 1928 endeavour was concentrated on improving the radiant efficiency, and ensuring the attainment of a satisfactory hygienic standard, and little, if any, consideration was given to the importance of other factors, such as the quality of the heat and the psychological appeal of the fire itself.

In a short paragraph entitled "Attractiveness," the Authors make reference to the fact that psychological and æsthetic considerations are of importance.

As is known, over a period of years we devoted considerable attention to the inter-relationship of the quality of radiant heat and the sensation of comfort experienced by individuals exposed to a fire. We were able to show that the sensation of comfort was increased if the radiant heat emitted contained an increased proportion of short infra-red energy. The general brightening of the appearance of lighted gas fires which followed had the effect of rendering the designers more conscious of the importance of the appearance of the incandescent mass, and the development emphasized the danger of objection on the score of glare.

To-day we are concerned even more than ever with the possibility of attaining general acceptance of these appliances as satisfactory substitutes for the solid fuel fire. It is realized that, on the one hand, there is need for a high temperature source or a selective emittor, which will give a high proportion of short infra-red energy, but it seems to me one of the essentials of the ideal fire is that it shall suggest restfulness. If a coal fire or, for that matter, an incandescent coke fire, is restful, why is it? The solid fuel fires may have three distinct features:

(1) The brightly incandescent masses are surrounded by, or intermingled with, relatively large black masses—that is, a noticeable contrast is provided.

(2) The build-up of the solid fuel fire provides a deep incandescent mass, and it is not possible at a glance to get a complete picture of the make-up of the fire; something is left to the imagination.

(3) In many cases they are absolutely silent in operation, at least over considerable periods.

Masking of Detail.

The columnar radiant gas fire, on the other hand, with its lace-like structure, skeletal in appearance, is obviously shallow and leaves little to the imagination. In fact it has been designed deliberately so that the whole of the heated mass is seen readily from the front. It seemed desirable, therefore, to work along somewhat new lines and try to design gas fires which should, in essence, consist of a single large, brightly incandescent combustion chamber, uniformly heated if possible, so as to give a "full radiator" effect and mask details—I regard the masking of details as important—the whole to be covered in the front by an irregular screen of heavy structure, through which the highly heated surface of the refractories should be viewed.

The first fires embodying this conception were completed about eleven years ago, and were referred to in the Technical Press in 1930. These were of the inset type with black cobbles heated by luminous flames, and were put on trial in a number of private houses.

Subsequently the idea was developed further in a hearth pattern fire. After many years' experience with these fires in my own home, I feel they provide the most satisfying gas heated source of radiant energy yet available for the warming of a living room, and this opinion seems to be shared by those who have had experience with them. When cold, the appearance is not so pleasing, but I am convinced that the idea underlying the design is sound in principle; a single combustion chamber at a high temperature viewed through interstices in a heavy refractory mask. The shapes of the fires may be made to suggest that they provide a deep incandescent mass. In addition, if the heating is effected by the use of luminous flames, there is ensured absolute silence, which has never really been attained in the gas fire heated by bunsen flames—a fact of considerable importance from the psychological standpoint.

We continued to develop these conceptions of gas fire design, but, in discussing matters with members of our staff, I found marked differences of opinion to exist as to what is the ideal form for a gas fire. It does not follow that what is felt to be ideal for a solid fuel fire is, of necessity, ideal for a gas fire. The provision of a front screen, obtained by massing together a number of blackened cobbles, is much liked by some but, on the other hand, it is objected to strongly by others on the ground that it suggests an imitation, and that of something which is "old fashioned" and not particularly pleasing—namely, the solid fuel fire. The people holding this latter view, however, reacted favourably to a formal design, and a second type was developed, embodying a series of parallel members, heavy in structure, to serve as the front refractory screen through which the combustion chamber is viewed. The resulting design is markedly different from the radiant fire of the past. We are able still to attain the "full radiator" effect, and the complete silence, due to the use of luminous flames. This latter fire has the additional advantage of emitting energy of high penetrancy, approaching in quality that yielded by the clinical gas lamp, which was designed originally for therapeutic purposes.

Two Schools of Thought.

During the last year or so we have been able, thanks to the kindness of a number of engineers, to try out these two types of fire in different parts of the country. The experience we have gained with different undertakings has emphasized the existence of the two schools of thought to which I have made reference—namely, those who like the imitation solid fuel fire, and those who wish for a fire of formal structure, be it of the inset or ordinary hearth type. The preferences shown to date have suggested that the formal structure may ultimately have the greater appeal. No doubt, in the future, we shall arrive at an effective compromise between the "ancient" and "modern."

Now with regard to my second point, the Industry has not been able yet to attain the same success in popularizing town gas for domestic heating as it has done in the cooking field, and while this may, in part, be due to factors such as those which I have discussed, it results largely from the cost of employing town gas. When "half price gas" is really obtainable, there will be a big development in the demand for gas fires. The two-part tariffs at present offered by the Industry seem, in many cases, however, to go but a little way in the direction required. For example, there was brought to my notice recently a case in which an advertisement was issued by a gas undertaking, advising that "half-price gas" was obtainable. The usual enquiries were made, and it was learned that a change over from the inclusive tariff which had been charged to the new "half-price gas" tariff would have resulted in an increase of outlay from £27 5s. to £29 10s. per annum for a consumption of 670 therms. Price parity would only have been attained following an increase in consumption of about 27,000 cu.ft. per annum. One effect of the gas undertaking's communication was to cause serious consideration to be given to the use of coke fires, owing to a natural objection to the paying of a price which must be capable of subsidizing the increased use of gas by other possibly smaller domestic consumers in the district. It should, at least, be ensured that the two-part tariff will not involve an increase in the average price per therm to be paid by a good consumer. It would be interesting to know what percentage of those who have been offered two-part gas tariffs have found it profitable to accept the proposals made.

In the Paper which Dr. Davidson and I presented to the Institution at the last meeting, it was pointed out that gas costing 4d. per therm should prove more economical to use in a gas fire than coal costing 2d. per therm (50s. per ton) used in an open hearth fire. That view is endorsed in the present Communication, and no suggestion is now made of a case for the general use of the gas fire with 6d. gas, such as was advocated by Mr. Andrew in November last.

"Efficiency and Efficacy."

Dr. Margaret Fishenden (Imperial College of Science and Technology): To one such as myself, who has watched with great interest the progress of gas fires and other appliances, a Paper such as that by Mr. Andrew and Mr. Barron betokens a most promising line of development. As Dr. Hartley has pointed out, in the early days, perhaps inevitably, attention was directed mainly to thermal efficiency, although not entirely, of course. But there are many factors other than thermal efficiency which affect the value of gas appliances, and I am inclined to think that in comparisons "efficacy"

would be a better term than "efficiency." Of course, it is essential to know and to be able to measure the thermal efficiency; but there are other points which must also be taken into account. I have often pointed out that not sufficient attention has been paid to the distribution of the heat; I mean both the distribution as between radiation and convection, and also the geometrical distribution. Efficiency is not enough. Actually one can quite well conceive of appliances having 100 per cent. efficiency, but having practically no efficacy. Imagine, for instance, a convection heater in an extremely badly insulated room; imagine a high-temperature radiation heater in a transparent room; or, to come to more practical cases, imagine a non-radiant flueless air heater immediately underneath an open window, or imagine a large gas oven which is kept going simply to cook a single pie. The conclusion from those remarks, of course, is that the best equipment depends on requirements, and I have often wondered whether it would not be a good idea, in large estates of small houses, for the choice to be given to the prospective tenants, because what suits one sort of family would not necessarily suit another at all.

Coming to the question of comfort, I am inclined to suspect that skin temperature has a good deal to do with that. We have heard Sir Leonard Hill, and I should like to hear more from the physiologists on this matter. I should not be in the least surprised if it were found possible to correlate comfort fairly closely with skin temperature, because, after all, it must be through the skin that the body receives the stimulus to adjust itself to changes in environment. Although, as Mr. Andrew has pointed out, if you have fairly uniform conditions over the body, checking and counter-checking from physiological data shows that there are fairly safe grounds for relying on calculation to find what change in the temperature of the surroundings would be necessary to counterbalance any given change in the air temperature, I think that when we come to the highly localized effect of a small high-temperature fire we are on very much less safe ground, and I am inclined to think that more work is needed on the geometrical distribution of the radiation over the surface of the body. Without having given anything like enough thought to it, I would venture to make a guess that something like the following sort of distribution would probably be good—a minimum amount of heat at head level, a moderate amount at chest level, probably rather a good deal of heat around the waist level, a moderate amount around the knee level, and perhaps a good deal again at foot level. That matter, I think, would repay investigation.

There are one or two points of detail in the Paper with which I do not quite agree, but quite obviously, in a subject so complicated as this it is utterly impossible to do anything except to proceed step by step, and ultimate conclusions can never be reached except as the result of a good deal of work, by the trial and error method, and so on. I do not quite like the idea of using flueless gas fires in mild weather. I think I know what is at the back of the minds of the Authors in making that suggestion; but at the same time, it does seem that it is exactly in mild weather that one needs a little high-temperature radiation to top things up, and does not need a flueless heater.

I do not agree with the assumption that the non-heated building would necessarily have anything like the same temperature internally as that obtaining outside. If you had a building containing a good deal of glass through which sunshine was passing, it might be warmed to much above the outside temperature; if you had a building with a very badly insulated roof, such as a corrugated iron shed or something of that sort, then on a clear frosty night, when the effective sky temperature might be a good many tens of degrees lower than the air temperature, that building could cool down very much below the outside air temperature.

Missenard's Scale.

Dr. Thomas Bedford: There are one or two points which seem to me to call for some comment, being concerned mainly with Section III, which deals with comfort. The Authors have enumerated the environmental factors which affect the heat-loss from the body and thus influence sensations of warmth, and then they state that there is as yet no single index applicable to various methods of heating. That section of the Paper is very much condensed, and I take that statement to mean that there is not available a single index which allows for all those environmental factors satisfactorily. That is hardly right. Missenard has put forward a scale of resultant temperature which allows for all the factors. It is true that, in a report published three years ago, I referred to difficulties in the application of that scale; but since then Missenard has removed those difficulties and the scale has been used successfully.

Before the war, Sir Leonard Hill introduced his kata-thermometer, and on wet kata-thermometer readings one did get some allowance for each environmental factor. The humidity of the air influences our sensations of warmth, but it also affects comfort in other directions. A dry atmosphere is more invigorating than a moist one, quite apart from warmth, and if the relative humidity exceeds about 70 per cent., feelings of wetness are likely to arise. At temperatures up to about 70° F. a considerable change in the relative humidity has little effect on the feeling of warmth; so that from the point of view of warmth we can afford to ignore changes in humidity at the temperatures which are commonly encountered in occupied rooms in this country during the heating season. If we do ignore humidity in our considerations of warmth, the remaining factors which influence warmth sensations are the temperature and rate of movement of the air and the radiation from the solid surroundings. Those three factors are all taken into account in Dufton's scale of equivalent temperature, which was devised at the Building Research Station. Of the various scales of warmth which I have used in a study of the comfort of persons engaged in light occupations, equivalent temperature was the one which was most highly correlated with warmth sensations.

Equivalent temperature makes adequate allowance for the influence of air movement. Where there is but little air movement, as in a closed room, the globe thermometer is a valuable index of warmth, since it makes due allowance for radiant heat.

The Authors have referred to the work of Dr. Fishenden and Mr. Willgress on radiant heating and have said that the latter Authors could not get comfortable at air temperatures below 45° F. It might well have been added that at temperatures below 51° or 52° F. they were not actually very comfortable, because at that sort of temperature they were beginning to experience unpleasant feelings of scorching on one side and chilliness on the other. I suggest that the minimum desirable air temperature of 50°, mentioned in the section of the Paper by Mr. Andrew and Mr. Barron dealing with optimum comfort requirements, is too low, and that 55° would be a better temperature.

Standards of Ventilation.

Discussing standards of ventilation, the Authors mention that the standards which at present prevail have been determined on a body odour basis. The amount of fresh air required to keep body odours from becoming perceptible varies with the density of occupation and with the cleanliness of the occupants; but the figure mentioned (1,000 cu.ft. per person per hour) is probably not far wrong as a rough average. It does not apply always. It does not follow that that amount of fresh air will ensure ideal ventilation. Sir Leonard Hill has often mentioned that subjective feelings of freshness or of stuffiness depend very largely on air movement, or lack of air movement. In many rooms which are sparsely populated a fresh air supply of 1,000 cu.ft. per person per hour will not be enough to ensure appreciable air movement, and feelings of stuffiness may well arise. But, although I have referred to the importance of air movement, I would scarcely go so far as Mr. Andrew and Mr. Barron have gone when they have stated, in the section of the Paper in which they deal with unit heaters, that the prevention of stagnant air banishes the chief cause of human fatigue.

With regard to the section dealing with factory heating, mention is made of the air stratification which occurs with some methods of heating, the air in such cases being several degrees warmer at head level than at floor level. The importance of avoiding these temperature gradients should be emphasized. Such stratification leads to discomfort through cold feet and feelings of stuffiness in the head. More than 80 years ago the Commissioners appointed by the General

Board of Health to enquire into the ventilation and heating of dwellings emphasized this very strongly and made countless observations of temperatures at different heights above the floor. But in spite of the fact that the information was put into a Blue Book, people have installed in factories methods of heating which are atrocious from that point of view. You will find overhead steam pipes slung in a grid iron 10 ft. or 15 ft. above floor level in single-storey buildings. The temperature at head level may be anything up to 10° higher than the temperature at floor level, so that people suffer from cold feet and stuffiness in the head. Such conditions are entirely undesirable. Methods of air heating were often guilty of giving rise to that sort of trouble. The older hot air heating installations were designed to heat relatively small volumes of air to a very high temperature, and they often produced undesirable temperature gradients. One of the main advantages of the modern unit heater is that it handles large volumes of relatively cool air, and disperses it so that the temperature gradients are negligible.

An overheating of the head and chilling of the feet is undesirable, whether it be due to air stratification or to localized radiant heat. Plate 8 illustrates high-temperature radiant panels. The angle at which the panels are hung may be such that the heads of the occupants of the building are not exposed to excessive radiation; but the workers are seated at benches and their legs and feet are thus screened from radiant heat. It may be that this particular building presented a difficult heating problem, but I am left with a suspicion that the occupants would suffer from cold feet.

I was very glad indeed to hear Sir Leonard Hill again this morning, and his remarks provoke me to make some reference to the quality of radiant heat. Sir Leonard has outlined his findings and has mentioned some findings which were denied. I am one of those who have denied one finding. Some years ago Mr. Dufton (of the Building Research Station) and I were asked to make observations of the phenomenon which Sir Leonard Hill has described, and we found that any sudden application of heating to the skin might provoke stuffiness in the nose, whether that heating was by radiation or convection or hot air or even by direct conduction. You could put a hot fomentation on a man's arm and give him a stuffy nose. We found that any type of radiation that we tried would provoke this stuffiness. Sir Leonard said this morning that direct radiation from the sun penetrates deeply into the skin and does not provoke stuffiness of the nose; we were very successful, however, in provoking this stuffiness by direct unobstructed radiation from the sun. We were not able to find any antagonism of different types of radiation. As Sir Leonard has said that our experiments were unsatisfactory, it is with some diffidence that I venture to suggest that our experimental method was probably not greatly inferior to that employed in his earlier experiments in which he demonstrated this phenomenon. I have read with the greatest interest the work of Lehmann, published at the beginning of the year, and in which he confirms Sir Leonard's findings; but against that we have the observations made by Mr. Dufton and I, and other very careful observations made at about the same time. American observers have not only confirmed our findings, but went further and suggested that possibly psychological influences were responsible for some of the findings reported by Sir Leonard. I do not suggest that it was Sir Leonard's reaction, but that of his subjects. For instance, by putting on an electric light bulb, giving bright radiation, there was some alleviation of congestion in the nose. Later some alleviation was found when the light was not switched on. I have recorded the pressure on my nose without applying heat to the skin, and have set out deliberately to produce stuffiness. If I could do that by voluntary action, I think it is not too wild a suggestion to make that through some psychological influence there is a possibility of the nose becoming stuffy.

Potential Undeveloped Domestic Heating Load.

Dr. H. T. Angus (Parkinson Stove Company): This Paper illustrates in a startling manner the potential undeveloped domestic heating load. It is very satisfactory to note that attention is being drawn to the different comfort levels which are desirable in different parts of private houses, and also to the different forms of appliances which can be satisfactorily employed to give the most suitable form of heat at an economical rate. Dr. Fishenden and Mr. Willgress in 1925 drew attention to the economy of using localized radiant heat in large rooms as compared with overall room heating to raise the entire air temperature, and directional reflection of heat is a matter to which my own Company have paid special attention.

The introduction of portable flueless gas fires has been caused by the competition of the portable electric fire, and it is satisfactory to note that the use of flueless gas heaters has received the approval of the Royal College of Physicians within the normal limits of consumption. Nevertheless, if gas is to maintain its position in room heating it should concentrate on those forms of gas heat in which it has unquestioned superiority—namely, the flued gas fire, and pressure should be brought to bear on local Authorities to make adequate ventilation in a certain number of rooms compulsory, and the advantages of fitting ventilated gas fires as an integral part of the building, particularly in bedrooms, should be brought home to speculative builders.

The estimated cost of heating a living room of 1,500-2,000 cu.ft. capacity corresponds closely with our experience, bearing in mind the difference in the price of coal between London and the Provinces. Approximately 800 therms per annum are required in actual coal consumption, assuming an average heating efficiency of 20 per cent. as compared with 300 therms for a gas fire operating at 50 per cent.; and while the lower price of coal in the Provinces reduces the advantage of gas over twelve months from 35s. to 10s.-15s., the margin is still high provided gas can be supplied at 4d. per therm. Unfortunately, the heating of a house cannot be considered in terms only of sitting rooms and bedrooms, and it must be remembered that in a very large number of houses, the fire which heats the kitchen, and frequently the living room, also supplies hot water, and frequently also provides cooking accommodation. Even taking this into consideration, however, and allowing for the additional cost of gas heating to produce the household supplies of hot water, there would appear to be a possible saving of 10 to 15 per cent. by the use of gas at 4d. per therm, as compared with coal at 40s. to 45s. per ton.

Factory Heating.

In connexion with factory heating, the contribution of gas lighting to the heating of factories might be recognized. It has been demonstrated by Mr. F. C. Smith that with normal factory illumination to a level of 5 foot-candles, from 30 to 40 per cent. total heat requirements per room may be supplied by the gas lighting, and if heating and lighting were to be considered at the same time, it is probable that much more attractive terms could be offered than are at present possible with the introduction of gas-fired central heating, unit convector heaters, or overhead panel heaters in conjunction with electric lighting.

For workshops with large floor space it is evident that side panels and side radiators are quite unsatisfactory, and there would appear to be only three alternatives:

(1) Floor heating,
(2) Forced convection heating, and
(3) Overhead radiant heating,

and since overhead radiant heating is becoming much more prominent, at the moment, it would appear to be foolish to ignore gas lighting which serves the dual purpose of lighting and heating, and which has a relatively high overall radiant efficiency.

Mr. W. W. Nobbs (Institution of Heating and Ventilating Engineers): I feel sure also that a Paper of this character would be welcomed by members of my own Institution; co-operation between our two Institutions on a subject of this character, I think, would be welcomed.

The importance of automatic control is hardly stressed here, though it is so very necessary when gas is used. I should have liked to have seen that matter further stressed.

The Paper recalls to my mind another Paper, which was read by Dr. Taylor at the Public Works Congress in 1935, on the utilization of gas in public buildings. Both that and the present Paper are very useful.

The estimated figures of gas consumption for heating, given in the Paper, appear to me to be optimistic. They are

put forward to the converted. I can speak from practical experience, for I have had two separate coke-fired boilers, one for heating and one for domestic hot water, and have changed to the use of gas. A charming representative of the gas undertaking informed me that I should be spending about one-and-a-half times as much on gas as I had spent formerly on coke, and I find in practice that I am spending a little more than twice as much. But I do not mind that in my particular case, because of the convenience. I have limited thermostatic control with night switches, but I have not the full automatic control whereby the rate of consumption is controlled by outside weather conditions. I think the latter would make a considerable difference, and I intend to have it installed.

I notice that in the cost figures in Table 9 in the Paper a figure of 4d. per therm is adopted for gas for heating, and it is stated that the standing charge is not included. I do not know whether that applies throughout, for I have not had time to scrutinize the figures, but if the standing charge is not included, of course, that will make a very considerable difference.

Economic Position of Consumers.

Mr. W. E. Benton, M.Sc. (Chief Chemist, Cannon Iron Foundries, Ltd.): When reading this Paper I was reminded of Matthew Boulton who introduced the steam engine to George III. with the words "I have to sell what all the world wants—Power!" If William Murdoch, who was then working for Boulton, could have foreseen the future of his experiments with coal gas, he might have said "And I shall provide the world with what it really wants—Comfort!" But comfort must be purchased, and the Authors rightly emphasize that the economic position of the consumer governs not merely the amount of heat he can purchase but the degree of comfort that can be associated with it. Here the Authors surprisingly omit to mention gas lighting. To-day the poorest section of the community is being tempted to buy electric light, which is cold; surely it is obvious that every time a gas undertaking fixes a gas light in a poor home it automatically includes the free use of a background heater. It is no business of mine to advocate gas lighting, but the logical conclusion to the argument put forward in this Paper is that poor people cannot afford to exchange gas light for electric light.

With regard to gas fires figures in the Paper show the improved distribution of heat obtained by inclining the radiants. By combining inclined radiants with a curved or V-shaped front we can reduce the concentration of heat centrally in front of the fire—and particularly on the hearth, where it is largely wasted—and thereby provide a more even distribution of heat throughout the room. To the purchaser of a gas fire the most important question is surely "How many people can sit round this fire in comfort?" It is admittedly not easy to combine good distribution with a pleasing design of the fire front, and in recent years the Industry has been persuaded by artists and architects that after all "one B.Th.U. is as good as another" and distribution does not matter—the most important thing about a gas fire is its artistic appearance, and the less it looks like a gas fire the better. Let us hope that this particular fallacy has now run its course.

I should like to ask the Authors whether their own work confirms Bedford's conclusion that for healthy conditions each person requires 1,000 cu.ft. of fresh air per hour. If this is true, and it does not seem an over-statement, it makes a powerful argument for the use of flues and, therefore, indirectly of gas. Four people playing bridge in a room of 1,500 cu.ft. would require a minimum of nearly three air changes, an amount readily provided by a gas fire. People are slow to realize the extent of contamination of the air in a badly ventilated room. One of the few excuses for smoking is that it provides an index of the concentration around you of other people's breath.

I think the Authors dismiss too lightly the objections to products of combustion. In a room with predominantly hard furnishings, such as a kitchen, workroom or the living-room of a small house, products of combustion are not objectionable, but I think it is a mistake to introduce flueless heaters into rooms where there are expensive curtains, upholstery, leather-bound books and polished woodwork. With gas at 4d. per therm the owners of such rooms can afford central heating.

With regard to the standards of comfort in English houses I would seriously suggest to the Authors that their human material is not nearly so reliable as in either colder or warmer latitudes.

A great many English people, unfortunately for the Gas Industry, are able to live in houses with unheated halls and bedrooms without any danger to health and with little discomfort. In fact, they take a pride in being "hardy." And at the other extreme are people accustomed to central heating who, I think, gradually increase their demands for heat until they are living in a veritable hothouse. Americans are already beginning to talk about "the cold 70's"! I would also suggest that the term "sedentary occupation" is far too wide a category. Between working and resting there is a big difference in comfort requirements, even when the work is without much muscular effort. You all know that the driver of a car on a long journey may feel comparatively warm while his passenger, who has nothing to do, is miserably cold. Another point which seems to be obscure is the stimulative effect of heat, properly applied, on the human body. That symbol of comfort—a hot water bottle—seems to have a warming effect on the whole body out of all proportion to the meagre number of B.Th.U.'s supplied, and most forms of radiant heat, particularly when associated with light, have an invigorating effect which convective heat does not evoke. The Authors' most interesting statement is that a high standard of comfort can be obtained when the environment is rather warmer than the air itself. Sixteen hundred years ago every large house in England was heated in that way. After so long an attachment to the barbaric open fire we begin to recognize the merit of the Roman hypocaust.

(Written contributions were invited, and the Authors intimated that they would reply to the discussion in writing.)

Installation of Tower Gas Purifiers

Communication No. 212

by

CYRIL M. CROFT, M.Inst.C.E., M.I.Mech.E., M.Inst.Gas E.

(Chief Engineer and General Manager, Wandsworth and District Gas Company).

The **President**: It has been said that there is nothing new under the sun, but I think you will agree that Mr. Croft has this morning presented us with a plant that is as near as no matter to something new in purification practice in this country. We are very deeply grateful to him for giving us this early opportunity of learning something of his experience, and I think he is to be congratulated on the very concise and graphic way in which has presented it.

Reliability and Low Cost.

Mr. E. V. Evans (South Metropolitan Gas Company): Although the purification of a gas by contact with a solid material would, physically, not appear to be an ideal procedure, and in spite of some doubt that still exists regarding the precise chemical mechanism of the process, it is a fact that the purification of coal gas by iron oxide has withstood every attempt to supersede it by processes using liquid reagents. The reasons are, in the main, the reliability of the process and its low cost.

The methods adopted for the operation of the oxide purification process vary from works to works to suit the particular conditions of the manufacturing plant, but I do not know whether it is generally accepted in the Industry that the process of purification by oxide of iron should be operated

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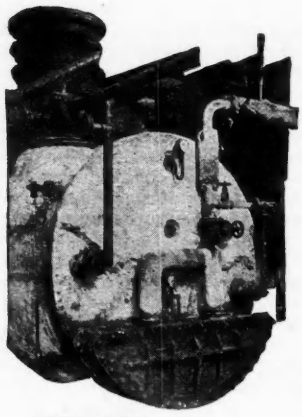

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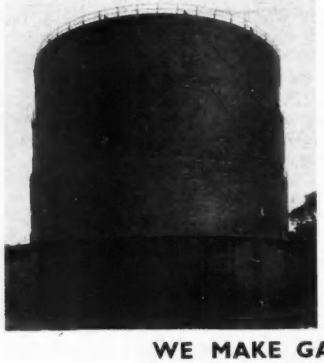

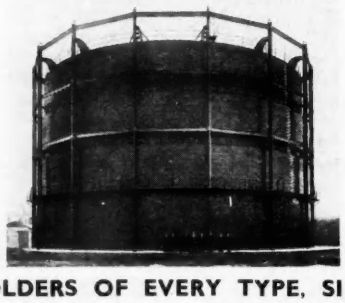

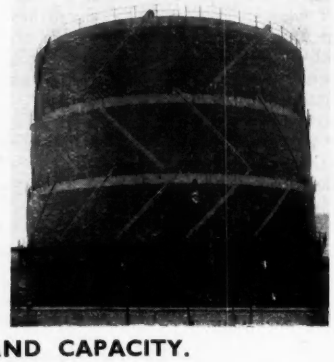

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in such a manner that hydrogen cyanide is extracted as well as hydrogen sulphide. To perform this double purification process adequately it is necessary that the crude gas should come in contact with iron which has been reduced to the ferrous condition, and this requirement places some limit upon the variations that may be made in operating details. It is also important that the process should be worked in such a manner that the gas leaving the purifiers is of low oxygen content—I would suggest an extreme upper limit of 0·5 per cent. and would prefer about half this figure. These are the considerations which decide the method to be adopted for operating the process. Over-all economy in purification costs is to be attained by attention to the first cost of the plant, to selection of suitable purifying material and by careful management of process labour. Records which have been collected over a number of years relative to the operation of rectangular box purifiers reveal that it is possible, on the average, to obtain sufficient revenue from spent oxide to meet the cost of new purifying material, while labour charges on the process can be limited to approximately 0·05d. per therm of gas treated. Some years ago, when it became necessary to construct an additional stream of purifiers at our East Greenwich Works, a careful examination was made of the possibility of installing mechanical devices that would enable the boxes to be charged and discharged with a smaller expenditure on labour, but the conclusion was reached that the probable saving to be made was too small to justify such equipment and, as ample ground space was available, the usual type of rectangular box at ground level was chosen. It is of interest to observe that the capital cost of this installation, amounting to just under £45,000 for an 8 million stream, proportionately equal to Mr. Croft's figure of £58,000 for a 10 million unit of tower purifiers.

Cost Below Overhead Boxes.

Where space is limited and the installation of rectangular boxes at ground level is impracticable, the Paper shows that the first cost of tower purifiers tends to be distinctly below that of overhead rectangular boxes and the advantage of the new system is manifest. What is not so obvious is the probability that tower purifiers may have considerable value in circumstances where the ground space occupied by the plant is not a first consideration. So long as the handling of coal and coke necessitated the employment of a large volume of labour it was not difficult to arrange for a box gang to be made available when the discharging of a purifier became necessary. With increasing mechanization of a works it becomes more and more difficult to assemble a sufficient number of men to carry out the operation expeditiously, and it is, of course, most undesirable to operate with one box out of action for any prolonged period. The tower system appears to offer an eminently practical means whereby the total man-hours required for charging and discharging may be spread more equally over the weeks and the process made more nearly continuous.

Mr. Croft has made reference to the phenomenon which he calls a bog stain and describes his procedure for dealing with this matter. The persistence of the last traces of hydrogen sulphide is notorious, and the South Metropolitan Gas Company has found it advantageous to operate a stream of six purifiers with Nos. 1, 2, 3, and 4 working in backward rotation, while Nos. 5 and 6 remain as catch boxes and are not rotated until it becomes necessary to change the charge in the first catch box. The new charge is then put to work as second catch. It would be of considerable interest to know whether the six tower purifiers would show the same advantage if operated in a similar manner.

There is a certain amount of evidence available to suggest that the removal of the last traces of hydrogen sulphide is rendered more difficult by bacterial action which proceeds in certain types of purifying material and results in the formation of hydrogen sulphide. The destruction of organic matter by preliminary working in one of the earlier positions in the stream, coupled with the reduction of the moisture content, are factors which help to restrain this action. It is not improbable that it was these facts of which Mr. Croft made use in carrying out the procedure that he has described.

Mr. Geo. C. Pearson (Birmingham Gas Department): The system of purification described in the Paper was brought to my notice some years ago, and it is most interesting to see that it has been developed satisfactorily at Wandsworth. Mr. Croft is to be congratulated on its successful adoption. We have under consideration in Birmingham a layout of purifiers for a proposed extension of an existing works and have been awaiting with interest results from Wandsworth. I very much regret that the working costs of Tower Purifiers show no savings over our present plant. The obvious and very substantial advantage of this system is the great economy in ground space. I feel, however, that in the prior considerations affecting this Paper certain factors have not been adequately assessed when compared with recent modern purifiers.

In Birmingham in 1928 a reinforced concrete building with 24 cast iron purifiers in one nest was erected with a capacity of 16 mill. cu.ft. per day at a cost of £85,000. This would be equivalent to about £55,000 for a 10 million plant, as against Mr. Croft's estimate of £75,000 or £58,000 for tower purifiers. The cost of purifying depends largely upon the efficiency of mechanical handling, and it appears a plant can be laid out on the old lines for cheap working costs fully equal to the tower purifiers, and equal in efficiency.

Again, referring to the figures given for the estimated cost per therm for purification by tower purifiers is 0·0343d. per therm. This would be regarded as high in Birmingham where we have achieved a purification cost of 0·0124d. per therm averaged over a period of ten years on the plant referred to. In the Birmingham plant we are able to discharge the spent oxide in one change, having a sulphur content of approximately 50 per cent., while the oxygen content in the finished purified gas is less than ½ per cent.

However, I realize that Mr. Croft's choice was restricted both by the considerations of space and possibilities of still further increased outputs. There are certain gas works where such a plant would be invaluable, and this Paper will be of the greatest possible assistance to the managements concerned.

An interesting point that has not been touched upon by Mr. Croft is the back pressure thrown by the plant, as an extra inch of back pressure is a serious item in the cost of steam on the exhausters over a period, and it would be interesting to have the figures for this plant compared with those of the original plant.

Smaller Undertaking's Opinion.

Mr. R. G. Shadbolt (Past-President): Having been intensely interested from the point of view of the severely practical gas man in the question of simple purification, dry purification, during the whole of my active life in gas management, with possibly the point of view that presents itself to one in a smaller area, who has to handle plants of smaller capacity than that dealt with in the Paper, and considering also that those concerned with smaller plant are in the majority in the membership of the Institution, perhaps I may be permitted to speak from that standpoint. I have selected as an instance a plant which I was called upon to design, and the operation of which I supervized, some 35 or more years ago.

The situation placed before us by Mr. Croft, and the manner in which he has dealt with that particular situation, is most intriguing and, to anybody having an ordinary engineering inquiring frame of mind, the Paper is most attractive. It sets out the considerations affecting the selection of purifying plant, and it is pointed out that any departure from the simple system of rectangular cast-iron boxes on the ground level, must provide justification from the point of view of one or more of the following points—reduction in the floor space occupied by the plant, lower cost in construction and maintenance, and reduction in handling costs, and in the time required for changing the purifying material. No doubt the Author will hear from other speakers how they can make a better showing perhaps than he has been able to make on these respective points as compared with his old plant and on his old method of working; but under his conditions he makes an excellent showing.

Then one looks around in order to see whether any possible snags or disadvantages can be recognized, and one of the features which stands out, in the mind of an old gas man, is that there seems to be running through the Paper a tacitly acknowledged limit to the amount of sulphur that can be extracted in one given operation or one given cycle of the purifying vessels. It is not quite clear to me what is

really the determining factor, but there seems to be a determining factor which limits the sulphur content to the neighbourhood of 44-45 per cent.; and then we are led to understand that it is best to throw that on one side and to get the best price we can for it as spent, and to use new material. With the old style of working the processing or operating costs are in the neighbourhood of 0·086d. per therm of gas, and he has summed up the situation in regard to the tower purifiers by saying that they effected a reduction in cost to something like 0·03d. But others will say that their methods under the old system of working involve them in a cost of about 0·06d. per therm, and so on.

Yield from Spent Oxide.

A great deal depends, of course, upon whether or not one takes into account the yield from the spent oxide. But the Author has made it fairly clear, I think, that the figure for which he makes a most emphatic claim is the operating cost only, and that is 0·0343d. in the tower process alone per therm of output.

The plant which I have selected to set against this in a much smaller way is a one million per day plant consisting of four 45 ft. purifiers in a nest, simply erected in the open on a simple concrete foundation and operated by a centre valve, so that we can have all four on or any one between No. 1 and No. 4. This plant is an interesting exception from the ordinary, inasmuch as it marks the birthplace of what became known as the bar system—namely, with loose bars, or grids made with wider bars or wider spaces than usual, so that the purifying material can be placed on the top and can trickle down and be levelled when full, with the oxide held on the bottom floor as lightly as it can be. That, in conjunction with backward rotation and the upward flow of gas, resulted in a state of affairs which was exceedingly satisfactory. To begin with, those purifiers lasted about two years without change. It was quickly discovered that this method of working caused the deposited sulphur to concentrate absolutely on the first tier of oxide on the bottom. There was a danger in operating for two years without changing for the simple reason that during the second winter any little upset in working might precipitate back pressure and so cause trouble. Eighteen months was found to be an ideal period or cycle; but again, that meant that every three years we came up against making the change during the winter period possible. Eventually, it has worked itself down to a yearly cycle, and since that was adopted the purifiers have been changed during the summer six months, whether they want it or whether they do not. The back pressure factor was the determining factor. The sulphur content of the spent oxide over all that period has varied from 60 to 80 per cent. When we were working the two-yearly cycle the highest content of sulphur in any batch was 82 per cent. It was bone dry and simply broke up into lumps, so that it was not very difficult to dig out. When the period of the cycle is reduced from two years to one year, naturally it has an effect upon the sulphur content. During the last three years I have had figures taken out, and the average sulphur content of the oxide put aside as spent was 64 per cent. over that period. During that three years the selling of the spent oxide containing 64 per cent. of sulphur has affected the working costs in this way. The operating costs, which are mainly labour costs, are 0·0341d. per therm sold, as compared with the price for the tower process of 0·0343d. But when you take into consideration the cost of the new oxide which has replaced the spent oxide disposed of, and have credited the return on the spent oxide, that cost is reduced to £15 per annum over the three years, equivalent to 0·0052d. per therm sold.

Those are the results obtained with the old-fashioned rectangular boxes simply worked in conjunction with the bar grid system, backward rotation and upward flow.

Capital Costs.

Mr. K. W. Francombe (Whessoe Engineering Company, Ltd.): In Section IV., Mr. Croft contrasts the capital cost of tower purifiers with that of a reinforced concrete building and concrete purifiers, and finds the latter considerably higher. I imagine, however, that the price discrepancy might not be so great in cases where ground space were not of the same paramount importance as it is at Wandsworth and where consequently it would be unnecessary to have a four-story building. It would also be interesting to know how dearly—if at all—Mr. Croft has had to pay for his reduction of ground space to a minimum, by contrasting the cost of the tower purifiers with that of the more normal cast-iron boxes in a one- or two-story building, and also with the cost of the modern type arc-welded mild steel purifiers, such as some of us saw last year at the Stretford and District Gas Board's works.

Still referring to the question of capital costs, I wonder if I may ask Mr. Croft whether the electro-detarring plant, which comes before the tower purifiers and which was doubtless put in to safeguard the state of the oxide in the towers, would have been included if ordinary boxes had been used? I should be among the first to hope the answer to this question would be in the affirmative; but if it were not, then the capital cost of the electro-detarring plant must be added to that of the towers. The same remarks might also apply to the Harrison purging machine.

Finally, I think it would be very instructive if Mr. Croft would inform us of the back pressures through the towers and how they compare with the figures obtained with the more orthodox types of installation. I understand from the published data that the oxide is revivified entirely *in situ* and that the oxide is fouled to 44 per cent. sulphur, without external revivification. I, therefore, assume that the back pressure thrown does not increase very seriously throughout the cycle, and I imagine that this must be largely explained by the absence of any tar fouling of the oxide.

Departure from Orthodox Construction.

Mr. J. H. Dyde (North Middlesex): Of all plant associated with a manufacture of town gas, I think it is true to say that the oxide purifier has undergone less change in design from its original conception than any other plant unit, and a departure from orthodox construction as carried out by Mr. Croft at Wandsworth shows that he, at any rate, is not afraid to break away from established practice.

No doubt shortage of ground space in his particular case was a very prompting factor in the final selection of the tower type, but the fact remains that the choice was still an open one and that he had the confidence and courage to introduce a new technique to this country. His first half-year's results must be a source of satisfaction to him.

What appealed to me more than anything as a desirable attribute in the Author's account of the installation was its flexibility, working well, it is stated, from half load to 33 per cent. overload and discharging oxide in spent condition in one fouling.

The realization of so low a process cost, as given, is dependent on achieving this complete fouling in one exposure and the various precautions and operating conditions to ensure this result are well worthy of note. One of these conditions is that the temperature shall not be less than 68° F. or more than 110° F. A tower construction with a large surface area in a vertical plane is naturally a good heat convector and I would like to ask if any difficulties were experienced during the extremely low temperatures of December last in maintaining the temperature and activity of the oxide with the heating arrangements at the base of the tower and whether any condensation troubles were evidenced during that particular period.

If at any time temperature control has been difficult it may be that lagging of the containers would prove a feasible and desirable proposition. There is no mention in the test of the provision for including a supply of live steam should this be required under certain conditions.

Very fine arrangements are included for metering and supplying air for revivification *in situ*. It is stated that the whole of the oxygen is admitted with the inlet gas and I should like to know if Mr. Croft has considered admitting air only to such towers as tests show are revivifying, rather than passing it as indicated through those that are also absorbing.

Mr. Pearson, in his Paper to the Institution in 1929, gave a figure of 6·66 cu.ft. of oxygen per 1,000 cu.ft. of gas per day when using highly active oxide. That was given as the minimum figure; the maximum figure was 7·7. It is interest-

ing to note that Mr. Croft's plant actually gives a figure of 6·6.

Mr. Croft has so far used a purifying material of a very high degree of activity (no doubt the best Dutch), coupled with 30 per cent. of Lux. I do not know whether that was done to ensure successful working conditions during the early operation of the new plant, but I should like to know whether he proposes to continue using that percentage of Lux. I believe it is a German product, and in certain circumstances we might have difficulty in obtaining it.

Back pressure has been mentioned, and I should like to ask whether the changing of the boxes at 44 and, I believe, 43 per cent. sulphur was necessitated by increase in back pressure.

In dealing with the financial aspect of the new system no special item is included for plant maintenance from which I conclude that it is considered to be not more than the system it has replaced, though I would have thought the increased mechanization and necessity for more frequent painting of the external steel shells and the possible provision of some form of internal protective treatment, renewal of jointing rings of which there are a large number, would have given a somewhat increased cost under this head.

Mr. Croft, however, has shown very clearly that substantial savings can be made over the orthodox method in a plant of the size he has installed and it would be useful to know, apart from consideration of ground space, what minimum capacity of installation would be comparable in regard to capital outlay and operating cost with our present systems. Perhaps W. C. Holmes and Company, who have studied the Bamag-Meguin plants in Germany and interpreted conditions in terms of English practice could give us their observations of this matter.

Labour Saving.

Mr. A. C. Williams: The particulars in the Paper show that the adoption of the tower purifier has been justified on account of the savin gof first cost, saving of ground space, and cheapness of operation. From the point of view particularly of labour-saving, the tower purifier seems to me to represent a great advance on the old type of shallow box. The latter does not lend itself to mechanical handling of materials, and during the operation of discharging a considerable amount of manual labour is unavoidable. I think Mr. Croft is to be congratulated upon being a pioneer in introducing this type of plant into this country. He certainly deserves the best thanks of all of us for having placed so promptly and so completely at our disposal the information he possesses on the subject. I would ask him to add still further to the debt we owe him by supplying some further information on certain matters of detail. For instance, on reference to the drawings which accompany the Paper, I cannot find very much information about the construction of the oxide trays, and I think it would be very interesting to have full details as to the arrangement of sealing rings and the automatic lifting gear and the method of distributing gas through the trays. I think probably the model will help in that respect; but as it seems to me that those are the points upon which the whole efficiency of the plant depends, it would be of great advantage to have as much information as possible.

If I am correct in my reading of the Author's description of the flow of gas, it seems to me that it is led from the central gas inlet tube towards the periphery of the box, and therefore probably it would be more correct to speak of "inward and outward" flow rather than "downward and upward" flow, as he termed it. I should also like to know the thickness of oxide which is used in the tiers; and, of course, there is the point as to back pressure, which has been mentioned by other speakers. Information on the method of dealing with the trays after removal would also be interesting. I think he has said that he stacks them in the tower, but it is not quite clear what happens to them afterwards. There is also the question as to whether the operators have had the experience of oxide firing after they have been taken out of the towers.

It is obviously a very good result to obtain 45 per cent. of sulphur in a single fouling. I should be interested to know what percentage of air is added to the gas to obtain this result. The Author mentions the amount of oxygen after purification, but does not mention how much is taken out of the purifier.

I think it is a wise provision to make use of the Harrison purging machine before discharging the box. That seems to me a precaution which is absolutely indispensable when dealing with towers of the height described in the Paper.

Internal Revivification.

Mr. G. M. Gill (London): I should like to ask whether Mr. Croft has considered the complete internal revivification of the oxide. In the United States it has been the practice at a number of the large works—notably Philadelphia and Milwaukee, to revivify oxide completely in the box; and with competent chemical supervision there is no risk in that at all. One would have to be very careless to produce any trouble. In the United States the method adopted is to circulate the gas that is left in the box, which is going to be emptied, and then gradually admit air, which is noted by chemical test, and also to keep check on the temperature. If those two points are watched carefully the work can proceed and the oxide can be completely revivified, and the purifier put back into use without discharge. It seems to me that this system of tower purifiers lends itself very well to that method. I note that Mr. Croft is able to increase the new oxide to a sulphur percentage of 45 per cent.; but with the method that I am explaining it is possible that he will be able to get still higher with advantage.

Mr. E. G. Stewart (Gas Light and Coke Company): In 1932 I had the opportunity of inspecting an installation of these purifiers, which had a capacity of 42 million cu.ft. per day, in Hamburg, Germany. It was very attracted at that time by the system, and on reference to my notes I see that the only doubt in my mind as to its efficiency under British conditions was the possibility that the oxide might not be evenly fouled as the result of passing through so many trays in parallel. I should like to ask the Author whether he has any tests of the oxide contained in each individual tray removed from one of the towers which would indicate whether in fact the fouling has been uniform throughout.

While I welcome the use of hydraulic valves as a means of ensuring absolute tightness, I wonder whether Mr. Croft could tell us, having had experience of one cold snap, if he had any anxiety concerning freezing or, alternatively, whether the valves are fitted with steam connexions so that possibility of freezing can be avoided. The tower purifiers which I saw on the Continent were not equipped with reversing valves, and, here again, it would be of interest and value if the Author could tell us whether he thinks that the added cost and complication to give this facility is one offering sufficient advantages to make it worth repeating in future installations.

Finally, I note that so far oxide has been removed for sale from the towers after once running. It is probable that if it had been returned after the usual revivification it would have reached at least 55 per cent. and probably 60 per cent. of sulphur on the second removal. It would be interesting to know whether the present practice is only a temporary one until further experience has been gained and, if so, whether the present policy is dictated by a fear of causing caking in the trays, which I presume has not been experienced so far.

Continuous Removal of H_2S.

Mr. D. M. Henshaw (W. C. Holmes & Co., Ltd.): It is, I think, generally known that over a considerable period we have been investigating both in the laboratory and by building works-scale plant, various methods of continuous removal of sulphuretted hydrogen, both by washing and catalysis. It was by reason of the knowledge thus gained that we were all the more ready to investigate what may be described as mechanized oxide purification.

I wish to place on record the fact that our relationships with all those associated with the Patentees and Licensors have been, in every way, happy, and we have received the greatest courtesy and efficient technical co-operation from them at all times. This co-operation has existed over a period of nine years, since I first visited Hamborne to see the first installation of tower purifiers in 1931.

By-Product Ammonia

Communication No. 213

by

P. PARRISH, M.Inst.Gas E., F.I.C., M.I.Chem.E.

(Manager, Phœnix Wharf Chemical Works, South Metropolitan Gas Company).

An Inverted "Grid."

Mr. E. V. Evans: I would like to endorse Mr. Parrish's remarks as to the economic soundness of the system whereby ammoniacal liquor is concentrated at the individual gas works and sent to a central chemical works to be worked up into sulphate of ammonia. The economies that have resulted from the operation of this system have been of substantial benefit, both to the chemical works that manufacture sulphate of ammonia and to the gas undertakings who sell their concentrated liquor to the chemical works. It may be that we can regard this system as an inverted "grid," collecting small quantities of material from numerous points in order that the economy of a central manufacturing process on a large scale may be realized.

The transport over any appreciable distance of gas liquor containing less than 2 per cent. of ammonia is, however, too costly an undertaking to be considered economically, and before the advantages of central manufacture of sulphate of ammonia could be realized, it was necessary to devote a great deal of time and attention to the design of concentration plants. The problem of design was complicated by the fact that no economy would have resulted had the concentrating plant required much attention, for the whole object of the scheme was to avoid the employment of labour uneconomically. It was evident that the plant needed to be completely automatic and to display almost human intelligence in meeting abnormal circumstances which might arise in its operation. Mr. Parrish's account of how these results have been achieved makes fascinating reading, and is evidence of the very great advances that have been made in automatic process control. The concentration of liquor having been successfully achieved, new problems developed at the central chemical works in dealing with the hydrogen sulphide contained in the liquor and the conversion of this substance to sulphuric acid. From the Paper one would almost be led to believe that these problems were solved without difficulty; but it must be remembered that the account which Mr. Parrish has given is a summary of accomplished facts and not of tribulations encountered.

I think it is true to say that the relatively satisfactory revenue obtained by the London Gas Companies from by-product ammonia is due more to their ability to operate on a scale which is large enough to be economical, rather than to any particular technical mode of operation. I would add, however, that the marketing of by-product sulphate of ammonia to-day requires the maintenance of rigid standards of quality, and this is a condition which is not easily attainable when the output of the plant is small.

Automatic Control.

Mr. C. F. Botley (Hastings) (Chairman of the Liquor Effluents and Ammonia Research Sub-Committee): The disposal of the ammonia produced in the carbonization of coal remains a matter of concern and often of difficulty. Although normally the financial aspect may not be so desperate as was the case in 1930 and the following years, the yield from ammonia is insignificant and not worthy of its intrinsic value, having regard to the need in peace and war. We must still look to research for assistance in the production or utilization of ammonia. There is, for instance, the rather tantalizing problem of its use in the purification of coal gas.

The Liquor Effluents and Ammonia Committee of the Institution, of which Mr. Parrish is a valued member, have consistently recommended the concentration of ammoniacal liquor as a practical solution, and in this connexion the association of neighbouring works or the ideal of a central chemical works. The Author has had unique experience in this particular matter and his Paper affords confirmation of the Committee's recommendation, which it is interesting to note is being more and more followed.

At the Glyne Gap Works of my Company concentration of liquor has been practised since 1905, more recently with automatic control. It can be confidently recommended, even for small works, of which North Berwick is an outstanding example. Automatic control has simplified the problem, but whether all labour charges can be ignored, as the Author does in Appendix 5, may be open to question.

One is glad that Mr. Parrish has called attention to the matter of spent oxide, because of the several considerations which arise. If we can avoid the use of sulphuric acid or even obtain the sulphur in some other way, then if oxide purification is to continue, some uses must be found for this material, another justification for continued research.

A Considerable Difficulty.

Professor H. E. Watson (Professor of Chemical Engineering, University College, London): It is quite obvious that costs must be boiled down to the last penny, and in Appendix 1 the Author gives a figure of 4s. 4d. per ton for steam. Should not most gas-works have a sufficient supply of waste heat steam to effect this concentration?

Another question I should like to ask concerns the type of condenser which the Author has drawn. I believe the formation of ammonium bicarbonate is a considerable difficulty; indeed, that is hinted at in the Paper. Is the horizontal tubular condenser the best where you are likely to get choking by ammonium carbide, and if not, can another type be substituted?

There is another point regarding certain gas-works producing a very weak liquor. Why do these gas-works produce such a weak liquor? Cannot the problem be attacked at the base; cannot they concentrate their liquor a little more? Having once produced the 0·5 per cent. liquor, however, I do not see why it should be doubly distilled. Surely if it were introduced nearer the base of the still, as in an ordinary rectifying column, that would make it possible to carry out the distillation in one operation. Then I should like to ask whether open or closed steam is the most economical at the base of the column. Mr. Parrish has not specifically mentioned which is used.

Again, according to Appendices 2 and 4, apparently the whole of the fixed ammonia is wasted, or very nearly all of it. I am not quite sure, though, whether that refers to a plant which is intended to recover fixed ammonia or not, because later the costs of recovering fixed ammonia are given, but there is apparently very small recovery given in the Appendices 2 and 4. I am not quite clear why that is.

The crystallizer is, although of fairly long standing, an entirely different type of controlled crystallizer from the ordinary long type crystallizer, and it would be very interesting to have further details of its actual working. At what stage are nuclei formed, or are there no nuclei formed? Are they merely little chips? But assuming that we have got the nuclei, exactly how do they grow and does the saturator act as a classifier? That is to say, do the small crystals tend to rise, only the large ones going to the bottom? I have not seen the design of the saturator, so that it is very difficult for me to say exactly what goes on, but it would be extremely interesting to have more information. The method might be applied, I think, to other salts as well as to ammonium sulphate with very great advantage, owing to the small floor space.

Another point with regard to this crystallizer concerns the water balance. I know that in practice this works excellently, but it is not quite clear why, because you put in water and apparently you take out little or none, and yet the water does not accumulate. Also, at what points is it necessary to draw away or bleed off some of the mother liquor, because presumably cyanides and such like bodies accumulate?

The nitric acid plant, which I have had the good fortune to see, appears to be a model of efficiency. I believe it is working on crude ammonia liquor, presumably containing some sulphur. What happens to the sulphur, and could one work

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the plant on the concentrated liquor, simultaneously oxidizing the sulphur and the nitric acid to get a mixture of nitric and sulphuric acids, for that is what we require for making fertilizers?

Finally, Mr. Parrish mentions in the Paper that there is no other known way of utilizing ammonia and sulphur than by making ammonium sulphate. I should very much like to see some research—I am not sure how much has been done already—on the primary manufacture of ammonium sulphite, which would require no sulphuric acid plant, and the subsequent oxidation to sulphate possibly by means of suitable catalysts under pressure. That would save the whole of your sulphuric acid plant and its maintenance.

Compensation for Reduced Production.

Mr. F. C. O. Speyer (General Manager of the British Sulphate of Ammonia Federation, Ltd.): There is one definite, though I know involuntary, mistake in the suggestion that under the International Nitrogen Cartel arrangements compensation has been received by British factories in return for limiting their output to the demand. No British factory, by-product or synthetic, has accepted compensation to limit production. In view of the problem of unemployment in this country it has been the policy of the British Group in the Nitrogen Cartel to utilize to the full the export quota allotted to it and to take advantage of the fact that some of the Continental factories have agreed to accept compensation to reduce production. This has enabled British factories to produce at a higher rate than would otherwise have been the case. Mr. Parrish suggests that a false impression has been given to the general public of the price which gas undertakings are realizing for sulphate of ammonia, owing to the fact that the price quoted for sulphate of ammonia in the home market includes the cost of delivery to station, and Mr. Parrish suggests that all compound fertilizers containing N.T.K. are sold f.o.r. makers' works. The latter is no longer the case, as a considerable portion of the mixtures marketed by members of the Fertilizer Manufacturers' Association is now sold on a delivered basis, and this also applies to the concentrated complete fertilizers marketed by Imperial Chemical Industries, Ltd. In view of its numerous membership, the average cost of delivery of the British Sulphate of Ammonia Federation is a low one, and represents a percentage of the total cost which is so small that no farmer is likely to be misled on this score. Moreover, experience shows that neither the individual farmer nor agricultural merchant has the same facilities as the producer for obtaining the lowest cost of transport. I do not agree with Mr. Parrish therefore that the practice of quoting a delivered price gives a false impression. After all, neither Mr. Parrish nor I buy our shirts free on rail Manchester or our boots free on rail Nottingham. I am convinced from many years' experience of the home market for fertilizers that the flat delivered price has helped very considerably to popularize sulphate of ammonia and the other fertilizers which are quoted on that basis.

In another paragraph Mr. Parrish seems to suggest that commissions and other incidental expenses have now to be incurred for selling sulphate of ammonia which were unknown in the earlier years of the industry before the British Sulphate of Ammonia Federation came into existence. I believe that to be a fallacy. What really happened was that the comparatively few middlemen, to whom gas and coke oven undertakings then confined their sales in this country, deducted all these commissions and expenses before arriving at the prices which they were willing to pay to the producer. As the business was obviously a profitable one to the middlemen, it is, perhaps, legitimate to claim that these commissions and charges were higher than the charges which are now borne by the federated producers who now know exactly what they are paying and why.

Experience at Cambridge.

Mr. J. Hunter Rioch (Cambridge): Our experience at Cambridge fully bears out Mr. Parrish's statement to the effect that the vapour phase process is economical and very flexible in meeting different conditions caused by varying composition of crude liquor. During the last twelve months the NH_3/CO_2 ratio in our liquor has varied between 2·01 and 1·50, so that it will be appreciated that the question of flexibility is a very important one.

We find that the strength of the concentrated liquor can, with very little difficulty, be maintained at 20-21 per cent. NH_3 by weight and that control of decarbonation can be effected in several ways:

(*a*) By varying the temperature at which the CO_2 is tapped off from the cooler.

(*b*) By varying the rate of throughput of the plant, thus increasing or decreasing the rate of absorption of CO_2 by the ammonia which has gone into solution to form the concentrated liquor.

(*c*) By varying the still-head temperature slightly in relation to either of the above conditions.

There is, however, one respect in which our experience differs vastly from that given in Appendix 5, and that is the cost of repairs and maintenance. Our costs, including labour, work out at 2s. 4d. per ton of concentrated liquor. I appreciate, of course, that this may be due to local conditions, but it would be interesting to know the experience of other members on this matter. In our case corrosion of the castings is the most serious item, inner tubes in the preheater and cooler last only about two years and we have had to renew quite a number of other cast-iron pipes in the hotter parts of the plant.

We have definitely found more corrosion with the stronger liquor. Another matter of interest is the difficulty experienced with the lead-coated thermostat tube on the outlet of the coolers. We have had so much trouble with this that it was recently replaced by an antimony tube and experience to date indicates that the additional expense will be fully justified.

In one or two cases where we have used mild-steel pipes as a temporary connexion, we have found these are reduced to paper thickness after four or five months' use.

With regard to steam consumption, unfortunately I am not able to give any figures over an extended period, but over two test runs the average figure including steam for starting up the plant worked out at 20·1 per cent. of the weight of crude liquor distilled, or very little more that we were using when making a straight concentrated liquor of 16-17 per cent. NH_3 by volume.

Mr. Parrish's remarks on the establishment of central chemical works appear to hold out good promise for the future of by-product ammonia. It is interesting to recall that in the case of my own Company the loss incurred on the disposal of ammoniacal liquor in 1932 was over £1,700, while in 1935 after our concentrated plant was in full operation this figure amounted to £100. Since that time the figure has varied according to the amount spent on repairs and last year was £31, and it is estimated that for a full working year with the new vapour phase process we shall have a profit in the region of £250.

Finally, I am also interested in the description of the making of sulphuric acid from the H_2S in the saturator gases and I would like to ask Mr. Parrish whether he considers that the apparent advantages of this method are likely to restrict the market for and reduce the value of spent oxide in the future.

Subject of Much Thought.

Dr. A. Key: The ammonia problem, which became increasingly serious to gas undertakings during the later 'twenties and critical during the early 'thirties, when the price of sulphate fell to as low as £5 5s. per ton, has been the subject of much thought, experimental work, and large-scale investigation. A considerable proportion of this has been borne by the Liquor Effluents and Ammonia Committee of the Institution, which is only to be expected, since it constituted one of the two main reasons for the Committee's existence. Quite early in its life this Committee leaned strongly toward the solution of the problem which Mr. Parrish so well advocates in his Paper; you will find references to it in the earliest Reports. Other lines of attack were not ignored, however, and investigation of these led to the accumulation of much knowledge, some of which has already been useful to the Industry and more of which may be useful in the future. But the general result of the work was that the solution of the ammonia problem capable of the most immediate application was the conversion of crude gas liquor into concentrated gas liquor, the transport of this product to

some central works and its conversion at this works into a saleable ammonia product. In transferring this conclusion from merely a recommendation into an accomplished fact, no one has done so much as Mr. Parrish.

So complete is the Paper that one is tempted to think that the problem is here entirely solved. Yet there are points on which individual gas undertakings may have to think deeply before adopting any particular scheme. A few years ago the problem was "to lime or not to lime"; now it seems to be "to decarbonate or not to decarbonate, and, if to decarbonate, how to decarbonate." Yet these two problems are to some extent bound up with one another. The aim of partial decarbonation is to increase the ratio of ammonia to carbon dioxide in the concentrated liquor, and it is done by removal of a portion of the carbon dioxide. But it is also done to some extent by liming, by which the ammonia is increased without altering the carbon dioxide. This additional benefit of liming should be borne in mind by undertakings considering the matter. Unfortunately, no general recommendation can be made, much depending on the size of plant, composition of liquor, and desired strength of product.

So far as I have seen, Mr. Parrish nowhere states precisely why in some cases it is necessary to decarbonate in order to prepare a product of 20 per cent. strength, possibly because he feels that the reason is now well known. He merely states that in some cases it is not possible to manufacture such liquor without partial decarbonation. This is not quite true; it is possible to manufacture such liquor, but it is not possible to store and transport such liquor without crystallization taking place to such an extent as to cause considerable difficulties. This crystallization is avoided by partial decarbonation and the 7th Report of the Liquor Effluents and Ammonia Committee explains why and gives limiting compositions. Mr. Parrish also states that excessive decarbonation is disadvantageous because of the possibility of crystallization of ammonium carbonates caused by the increasing ammonium hydrate content of the liquor. This is not the case, at any rate for liquor concentrations so far visualized by the Gas Industry. Ammonium carbonates exist only to a small extent in such solutions, being converted almost entirely in presence of excess ammonia to ammonium carbamate, which is very soluble. The real disadvantages of excessive decarbonation are the danger of producing a liquor of density less than unity, with increased cost of rail transport, and the production of a liquor of high volatility.

Favour of the Vapour Phase Process.

When partial decarbonation was first introduced, it was accomplished by a sort of preliminary distillation in which carbon dioxide, but little ammonia, was removed. This meant that the liquor had to be first heated, then cooled and then heated again in the still proper, a process manifestly wasteful in steam. The possibilities of vapour phase decarbonation were shown in the 7th Report of the Liquor Effluents and Ammonia Committee, where it was observed that a less complete condensation of ammonia meant a still less complete condensation of carbon dioxide and an improvement in the final liquor such as would have been obtained by partial decarbonation in the ordinary way. Decarbonation had been effected, but in the cooling of the vapours from the still and not by pretreatment of the liquor. It was shown that this decarbonation cost virtually nothing, but that there were limits beyond which it was not practicable to go. It is gratifying to know that Mr. Parrish now favours this vapour phase process.

In looking to the future Mr. Parrish declines to assume that ammonium sulphate will continue to be the most suitable form in which to recover by-product ammonia. It should be realized that the only purpose served by the sulphate radical, which constitutes 75 per cent. of the weight of the salt, is as a vehicle to carry the ammonia to the soil in a suitable manner. It is an expensive vehicle, particularly when its acidifying effect on soil is taken into account, and its replacement by an acid radical which is itself a fertilizer or by one which is much cheaper, is something to be sought after. Mr. Parrish mentions phosphoric acid in this connexion, and this is particularly suitable since sulphuric acid is used in its manufacture and its use would not in consequence dislocate the sulphuric acid market. Nitric acid, prepared by ammonia oxidation, is another possibility, having the dual advantage of being a fertilizer and having its source in ammonia, but the dangers of ammonium nitrate manufacture must be borne in mind. Among the cheap acid radicals bicarbonate is the most obvious, and processes for the manufacture of this salt are awaiting development, while its fertilizing properties have been well established.

Progress in these directions may be slow, because the British farmer is never in a hurry to change his methods, but progress must come and the Gas Industry must be prepared to take full advantage of the market for better products when such markets are made available.

The Author's Reply.

Mr. Parrish: I will deal in writing with the points which have been raised, because they all need very careful reply.

But I should like to deal now with the point raised by Mr. Speyer, the General Manager of the British Sulphate of Ammonia Federation. It is perfectly true that we do not buy our shirts at Nottingham, but buy them delivered in London; we do not buy our boots in Northampton, but we buy them delivered in London. But Mr. Speyer has a very difficult problem, and he has a very awkward question to answer. The fact remains that, if you take the seasons' prices for sulphate of ammonia over the last two years, gas-works ought to realize something of the order of £7 9s. per ton; the amount that has been paid by the British Sulphate of Ammonia Federation to the works which are members of that organization is less than £6 per ton. In other words, it costs to-day to sell sulphate of ammonia something of the order of from 35s. to 37s. 6d. per ton. There is no justification for such an expense. I agree that the British Sulphate of Ammonia Federation is faced with a difficult problem; but it must be remembered that the gas-works were in the field in this country long before the synthetic ammonia manufacturers, and the gas-works are entitled in preference to anyone else to receive the highest possible price for sulphate of ammonia. They are not receiving that to-day, and I shall not be content to leave the position where it is. I am determined that gas-works shall receive adequate compensation for their ammonia. The fact is, in the main, that until recently we had only one synthetic ammonia works, erected at a vulnerable place; it is true that another has been erected near Scunthorpe. But by-product ammonia is the most effective defence item that is possible to the country. You cannot do without localized production of ammonia. Fortunately, gas-works are distributed throughout the country, their production is distributed; the automatic concentration plants which have been the subject of discussion this morning, afford an opportunity of producing ammonia in a really utilizable and economic form, and in time of emergency that ammonia will be infinitely more valuable than any synthetic ammonia that might be produced. Having regard to that fact, gas undertakings in this country are entitled to receive the full market price for sulphate of ammonia.

I want to apologize to Mr. Speyer for having suggested in my Paper that the British factories which restrict their production to the demand are the recipients of compensation. Mr. Speyer has made that position perfectly clear, and I thank him very much for having made it so conspicuously clear that a mistake of this kind will not occur again.

Less Formal Moments OF THE Institution Meeting

Social Events and Visits

RECEPTION AND DANCE

Year by year the reception of guests by successive Presidents and their wives on the Tuesday evening of Institution Week appears to the onlooker to become an increasingly exacting function, yet even in the terrific heat of the night of June 6 Mr. and Mrs. Robertson did not wilt as they greeted the seemingly endless stream entering the Great Room of Grosvenor House. And still this wonderful ballroom seemed able to stand up to the strain of accommodating the 1,160 guests who enjoyed the excellent hospitality provided, many of whom, in spite of the sweltering atmosphere without, remained to dance the last number at two o'clock on the Wednesday morning. Music by Jack Palmer and his Band was as popular as ever.

By time-honoured custom, the District Association of which the President is a member claims the honour of presenting a bouquet to the President's wife. In the regretted absence of Mrs. Blackburn, the Southern Association on this occasion was gracefully represented by Mrs. D. C. Cross, wife of the Immediate Past-President.

WANDSWORTH AND WORCESTER PARK

There seems to be some slight doubt about what constitutes a record for Institution visits, but Mr. C. M. Croft and the Wandsworth Company were faced with a formidable task on the Thursday afternoon in coping with more than 500 visitors to the Wandsworth Gas-Works and the Re-Distribution Station at Worcester Park. Organization, however, was completely equal to the occasion. As each motor-coach disgorged its load at the works, the visitors were welcomed by an amplified voice which, in tones even more honeyed than that of the "courtesy cop" of the highway, gave them unmistakable instructions for their own subsequent comfort. The result was excellent, and, under guides who knew their job thoroughly, an extremely interesting afternoon was spent.

We describe the works in an article on other pages, so we can now adjourn to the nearby Town Hall, where the visitors took tea at the invitation of the Chairman and Directors of the Gas Company. Returning thanks for the "ideal busman's holiday" which the Company had enabled them to enjoy, the Institution President said how interesting it had been to see at close quarters the purifiers which Mr. Croft had so ably described in his Paper at the morning's meeting. As soon as he, Mr. Robertson, had seen the Presidency looming ahead in the normal course of his progress in office, he had given much thought to some way in which he might be able to distinguish his year from that of others. In the upshot Mr. Croft and the Wandsworth Company had come splendidly to the rescue by completing and putting into action the first installation in this country of tower purifiers, and so, through no great merit of his own, Mr. Robertson's year of office would be memorable as the year in which tower purifiers were first inspected by members of the Institution.

In the course of his reply, Mr. Croft expressed the great regret of the Chairman, Mr. Frank Jones, at his inability to be present to welcome them in person. He said how greatly he appreciated the attendance of such large numbers of members and visitors to see the works, and he was particularly pleased that there was something novel to show them. If anybody wanted any further information on the subject of the purifiers, or any other matters connected with their works, he or his senior technical officers would be only too delighted to give it. He took the opportunity of expressing his gratitude to the members of his technical staff who had so ably supported him that afternoon. Without their collaboration, so enthusiastically given, it would have been impossible to organize the entertainment of such a large number of visitors.

WARM WELCOME IN THE WEST

What has been described as one of the best meetings of the Institution was on Friday fittingly concluded with one of the best outings, when a large party followed the time-honoured custom—and a happy custom it is, when possible of achievement—of visiting the President in his home town. On this occasion it was—be it said without any idea of those comparisons which are odious—made especially happy by a concatenation of circumstances, one of the strong links in which was the continuance of the perfect summer weather by which the whole of Institution Week was favoured. Who would not enjoy a visit at any time to the history-steeped and enchantingly beautiful West of England in which Bristol is situated, and who could regard it as less than a memorable treat when accompanied by the warmth of welcome extended to the Institution visitors?

We are told that the first real clue to the existence of Bristol is to be found in the form of a silver coin of Ethelred the Unready, whose reign began in 978. Nigh on a thousand years, and filled with stirring events such as form the foundations upon which this, our England, rests! Yet, with so much to remind them of the past, it was with the present that the visitors mainly concerned themselves, for time was short, and there was so much to see and do. The City of Bristol has not been content to rest upon the the glories of its immortal past, but aims at being truly both an ancient and modern city, and, as befits a community cherishing such aspirations, its gas undertaking is both old and new.

In a Worthy Setting.

Just what the Bristol Gas Company are doing for the city will be found recorded at length on other pages of the "JOURNAL." Here it will suffice to say that, on arrival of the special train from Paddington at Temple Meads Station, coaches were waiting to convey parties either to the Canons' Marsh Gas-Works (one of the Company's three manufacturing stations) or to the Gas Showrooms and Central Offices. President Robertson and Mrs. Robertson had accompanied the visitors on the train from town: and there were also with them the new President, Mr. George Dixon, of Nottingham, and Sir Frederick J. West (Senior Vice-President), with Mr. John Terrace, the Hon. Secretary. The travellers were quietly but firmly "shepherded" by the Secretary, Dr. W. T. K. Braunholtz, and his experienced staff.

Those destined for the showrooms and offices soon found themselves at the entrance to a building distinctive among so many distinctive buildings, which is dedicated to the service of discerning Bristolians. In Radiant House, so well and truly named, a brief half-hour was spent in sheer admiration, under the care of the genial Secretary and Commercial Manager, Mr. S. E. Halliwell, and his strikingly efficient staff. Who would wish for a return to the old days, when gas is said to have "sold itself," now that the "sweets" have been tasted of selling gas service under conditions like those prevailing at Radiant House? Right away from the goldfish pond to the air conditioning plant—to say nothing of the outstanding architectural features of the building itself—the uses of gas are demonstrated, as they deserve to be demonstrated, in the most attractive surroundings. The very atmosphere of the place is sufficient to fire with enthusiasm the staff who are engaged there, and this must be a point worthy of consideration, apart from the silent appeal made by the beauty and utility of the appliances displayed.

The Gas Company Entertain.

The spacious Victoria Rooms at Clifton were well filled with the visitors sat down to luncheon as the guests of the Bristol Gas Company, and received tangible evidence that the Directors are animated by the spirit of their city, which has given so much to the world throughout the years. Mr. George H. Boucher, the Chairman of the Company, presided, and colleagues on the Board who supported him were Mr. Frederick C. Burgess, Sir Francis N. Cowlin, and Mr. W. G. Verdon Smith, C.B.E. There were also with him the Lord Mayor of Bristol (Alderman W. A. Winchester) and the Lady Mayoress, as well as the Sheriff (Col. E. W. Lennard, T.D.) and Mrs. Lennard. Prolonged applause accompanied the presentation of bouquets to the wife of the President, to the Lady Mayoress, and to Mrs. Lennard.

In his reply to the toast of "The City and County of Bristol," the Lord Mayor referred to the great respect in which the Gas Company are held, and declared that the services of the Board,

and also of the staff, are available at all times when called upon in the interests of the city.

An Appointment Never Regretted.

The Chairman's welcome to the visitors was most cordial, and he expressed the hope that they would go away with pleasant recollections of the entertainment which the Company had been able to offer them. "You have," he said, "seen our showrooms, of which we are quite proud, and I hope you feel that we have every justification for that pride. ("Hear, hear.") We are also proud of our works, and I hope those who went there this morning will feel that the Company have brought their undertaking to the highest pitch of efficiency. This will be the greatest honour you can pay us." (Applause.) He coupled with the toast of "The Guests" the name of Mr. Robert Robertson, who was one of the guests that day. He said he thought the Institution of Gas Engineers had been fortunate in having had during the past year as their President a man of Mr. Robertson's knowledge and experience. At the time when the Company had to find a new Engineer, inquiry was made of one of the leading men in the Gas Industry, and after having gone through various names, he finished up by asking: "But why are you coming to London to talk about Engineers? Don't you realize that you have in Bristol a man who is absolutely fitted for any position in the Gas Industry of the United Kingdom?" So they did not trouble further. Mr. Robertson was appointed, "and," went on the Chairman, "it is an appointment which my Directors will join with me in saying we have never regretted. From the time of his appointment the Company has gone ahead, both in its services to the public and in its miserable return to the shareholders." (Laughter.)

On behalf of the guests, the President thanked the Directors for their generous hospitality, and the Chairman for his very kind remarks. He also thanked the members of the staff who had made it possible for him to be absent on frequent occasions during his year of office, without any anxiety on his part as to the progress of the work. So smoothly, in fact, had everything gone that he hoped the Directors would not get the idea into their heads that they could run the works without him. (Laughter.) He desired to thank also his colleague, the Secretary, for all the help that he had given him. When he was asked to undertake the Presidency of the Institution, he knew that he would have to rely greatly upon Mr. Halliwell's assistance. He therefore approached him, and Mr. Halliwell made only one condition for this help—namely, that when he (the President) was asked to visit the Manchester district, he should try to get an invitation for him also. (Laughter.)

On to Weston.

The afternoon was devoted to a coach ride to Weston-super-Mare, by way of that symbol of grace and beauty the Clifton Suspension Bridge—the monument to engineering skill, which spans just over seven hundred feet across the Avon Gorge. Reaching Weston, there was time to appreciate the spaciously-laid-out two-mile promenade. Then to tea in the Winter Gardens Pavilion, to the strains of music by the Municipal Orchestra. Waiting here to extend a cordial welcome to the visitors was the Mayor, Mr. Henry Butt, who is also Chairman of the Weston-super-Mare and District Gas Company. He was supported by the Deputy Chairman, Col. Gordon Flemming, O.B.E., M.C., D.L. The Chairman of the Lighting Committee, Councillor G. Wood, was also present. Many old friends, were delighted, too, to see Mr. James Taylor, the Engineer and General Manager of the Gas Company, on his own district, and to realize the enterprise and energy that he must devote to meeting the requirements of a go-ahead holiday resort like Weston, which caters amply for winter as well as summer visitors. What the pleasure seeker, or one in search of health, cannot find at Weston it must be difficult to get elsewhere. As the Mayor forcibly said in the course of his speech of welcome: "Nature has blessed Weston abundantly, and we have done our best to add to these attractions."

The return journey to Paddington was from Weston Railway Station, and was punctually embarked upon. Indeed, it should be remarked that the proceedings throughout the day were characterized by the hall-mark of efficient organization—close adherence to the time-table.

The President's Luncheon

A large number of distinguished members and guests, including leading representatives of engineering, science, and commerce, attended the Luncheon given by the President at the Savoy Hotel, on Tuesday, June 6.

The Toasts.

The Loyal Toast was duly honoured, and there followed a silent Toast to the memory of William Murdoch, the centenary of whose death is being commemorated this year.

The **President** proposed "The Guests," to every one of whom he extended a very warm welcome. First in order among them he wished to place the Chairman of his own Company, Mr. G. Boucher, whose kindness had made it possible for him to occupy the Presidential Chair. The Institution thanked Mr. Boucher, as the representative of all progressive Chairmen, Boards of Directors, and Gas Committees who in their persons and through their officials supported the Industry's national organization.

Next in order he welcomed other members of the gas family—representatives of the various organizations and committees, past and present, contributors of Papers and services in other forms. The members were particularly glad to welcome the President of the British Gas Federation, the President of the National Gas Council, the Chairman of the Federation of Gas Employers, and the Chairman of the National Joint Industrial Council for the Gas Industry, and several other organizations, in the person of Sir David Milne-Watson. He assured Sir David of the warm regard and affection of the Institution. [Applause.]

The Society of British Gas Industries was another very near relative, and he was glad to welcome the new President, Sir Francis Joseph, and the new Chairman of Council, Mr. Ernest West. He was still further delighted that one of their members, Sir Frederick West, was Senior Vice-President of the Institution. There had always been the closest collaboration between the members of the Institution and of the S.B.G.I. in the effort to improve plant and appliances, and it was good to know that the new Research Board would afford still more intimate collaboration for the good of the Institution in the future.

Among the guests from overseas gas associations, the President mentioned particularly Herr Müller, the President of the International Gas Union, two Past-Presidents of that body (Mons. A. Baril and Herr Fritz Escher) and two Vice-Presidents (Mons. Joseph de Brouwer and Professor Brender à Brandis). He again expressed the hope that their visit might prove not only happy and profitable, but that it might be the means of promoting friendship and goodwill between their respective nations and our own. The Institution had also the unique privilege of including among its guests two direct descendants of William Murdoch—Miss Murdoch Barrows (great-great-granddaughter) and Mrs. William Cullen, OB.E. (great-grand-niece).

Other guests he was delighted to welcome were representatives of kindred technical associations, and the President mentioned particularly Mr. W. J. E. Binnie, the President of the Institution of Civil Engineers, the oldest and most exclusive of engineering institutions. The presence among the guests of representatives of State Departments concerned directly and indirectly with the Gas Industry led the President to recall that in the part of the Celtic fringe to which he belonged the normal attitude towards Parliament was one of profound distrust, so much so that the official prayer was "Bless, O Lord, The High Court of Parliament now assembled and over-rule their deliberations for the people's good"—clearly indicating that such deliberations must be wrong! Whether or not members of the Institution shared such extreme views, however, they regarded the Members of Parliament who were present as exceptions which proved the rule; in any case, Providence provided compensations, and such departmental officials as Sir Duncan Wilson (Chief Factory Inspector), Mr. Damon (Chief Alkali Inspector), and Mr. Ronca (Director of Gas Administration) were the agents of Providence who performed the beneficent task of tempering to the gas lambs the blasted law and rendering the legal pills they had to swallow and the legal shackles they had to wear as agreeable as possible.

The Institution also welcomed another group of distinguished State officials—those of the Department of Scientific and Industrial Research, who were doing so much to promote research in industry by practice, precept, and material aid. He was glad to welcome Dr. Appleton (Secretary of the Department), Dr. Sinnatt (Director of the Fuel Research Station), and Dr. Whitby (Director of the Chemical Research Laboratory). The members of the Gas Industry appreciated all that the Department was doing to promote the economical utilization of our coal resources. They only regretted that there appeared to be a lack of appreciation on the part of the State of the value of their work. Thus, while the Department had given a comprehensive survey of the different classes of coal, which might be of great value to gas engineers in the choice of their coals, the State stepped in and took away the right to choose.

Last, but not least, the President expressed gratitude to the

Technical Press; they were, he said, the Industry's recording angels, and very efficiently and very kindly they performed their task. But they were more than that; they were friendly critics, discriminating and impartial, and always sympathetic, and on occasion they were the eloquent champions of the Industry's rights and liberties.

He coupled with the toast the names of Sir Arnold Wilson and Herr Müller.

Justice for the Industry.

Lieut.-Colonel Sir Arnold Wilson, K.C.I.E., C.S.I., C.M.G., D.S.O., M.P. (Vice-President, the Parliamentary Science Committee), responding, said that during the last six years in Parliament, he had gained some idea of the importance of the Gas Industry in this country and of the immense complexity of legislation affecting fuel as a whole. It was suggested that the Parliamentary Science Committee might have intervened to prevent the Industry suffering from a shortage of the right kind of coal. He could only say in defence that he was one of those who had done his best to prevent the passage of the particular Orders in Council without fuller consideration, and he was one of those who was responsible for urging the Government to appoint the Coal Distribution Commission, which was operating under the Chairmanship of Sir Walter Monckton, the deliberations of which Commission had doubtless included a very full consideration of the Gas Industry's case. Representatives of the Industry were being heard by the Commission, and he did not doubt that the Industry would get justice. Whether that justice would commend itself to the members of the Industry, he was unable to say!

Sometimes, he continued, Parliament was referred to as the "Gas House." His reply was always that he accepted the compliment, for gas was incomparably the best source of power and light, while its by-products enriched our fields and propelled our vehicles. The Gas Industry was the Industry above all in Britain which was entirely British in origin. In technique, in management, and in almost every development Britain had been able to lead the world in its development of gas. Therefore Parliament was complimented when it was associated with gas. Was there any other industry of which all the raw materials were entirely British?

Referring again to the Parliamentary Science Committee, Sir Arnold pointed out that it existed not to advocate, but to expound, the carefully considered views of the principal scientific and technical institutions in this country as and when necessary in connexion with legislation which might be before Parliament. It acted as a mouthpiece, and not as a megaphone. Its sole job was, first, to try to make sure that the associations knew what Parliament was doing, and, secondly, that Parliament and the various Departments of Government were able to consider in good time what the associations' views were. That was as far as the Committee wished to go, and he hoped it would be agreed that the Committee was fulfilling a useful function.

Relations between capital and labour in the Gas Industry were a model to which many other great industries might well aspire. The relations between the public and the Gas Industry had never been more satisfactory than at present, and those good relations provided standing proof of what good organization combined with good variety of method in approach and in ideas could achieve. The records of the researches of the Industry filled him with confidence for its future.

The next step forward, he hoped, for the Gas Industry, would be to develop the use of gas for the purpose of transportation, more particularly on our main routes. One heard little about that, but he knew enough of British industry to realize that when one did not hear anything it did not follow that a great deal was not being done. Our problems to-day were not what they were previously, thanks to the Gas Industry. The air we breathed nowadays, in spite of the development of the internal combustion engine, had become purer, thanks to the Gas Industry. We could warm a room and at the same time ventilate it with the assistance of gas; he had yet to learn that there was any other way of doing that so effectively as by gas, except by the open coal fire, which was both extravagant, and, in a great city, definitely antisocial. Those in the Gas Industry were using their brains and the products of the Industry to bring fertility to the soil and health to the people. Could any higher compliment be paid to any industry? Everybody knew that to be true, whether he belonged to the Gas Industry or to any other.

Home of Gas Technology.

Herr Hermann Müller (President, International Gas Union) responded on behalf of the representatives of overseas gas associations, and expressed warmest thanks to their British colleagues for the kind invitation to attend the meeting.

That meeting, he said, had this year quite a special importance and significance, in that the members of the Institution were able to commemorate the centenary of the death of their compatriot, William Murdoch, the discoverer of gas manufacture. By that discovery Great Britain had become the classic home of gas technology, and British engineers, a century ago, had introduced on to the Continent the art of gas making. Since that time the British Gas Industry, by its far-reaching research and the high quality of its technique, had achieved many notable advances. The results of their research and their engineering technique had been an example to all.

Therefore, British gas engineers and scientists could look back with pride on the achievements of the last hundred years and regard with confidence the future developments, since from the small and unpromising retort of Murdoch there had grown a vital and proud Industry which one could not imagine, in spite of all its difficulties, would ever disappear from our daily lives.

In the name of all overseas colleagues Herr Müller expressed warmest wishes for the centenary celebration and for a very fruitful and enjoyable meeting.

Mr. W. J. E. Binnie, M.A. (President, Institution of Civil Engineers), proposing the health and prosperity of The Institution of Gas Engineers, referred to a booklet published by the B.C.G.A. entitled "This has Made a New World," an admirable text book from which he had learned quite a lot about the Gas Industry. One fact which had surprised him was that in a modern gasworks no less than 80% of the heat units in coal was recovered in one form or another. When coal was used for electrical generation, however, only about 25% of the calorific value of the coal was utilized. He remembered the days of the old fishtail burner and the open hearth, when all the valuable products of coal went up the chimneys and helped to create those dense sulphur fogs from which London had suffered; and he believed the time was not far distant when it would be made a statutory obligation that only some smokeless form of fuel should be used in the open hearth. Gas, of course, had a very keen competitor in electricity; the latter had developed very rapidly, but for certain purposes there was no doubt that gas heating was far superior to electricity. With the electric radiator in a room there was no proper ventilation, whereas with a gas fire and a flue there was good renewal of the air.

Commenting on the extremely valuable work of the Institution's Research Sub-Committee on Liquor Effluents and Ammonia, Mr. Binnie said that water engineers wanted the effluents flowing into rivers to be as pure as possible, because they must depend more and more in the future upon river supplies for the community. The available reservoir sites near the big centres of population were gradually being used up. Therefore, any efforts towards the production of harmless effluents were very welcome, and particularly to the Water Pollution Research Board.

He coupled with the toast the name of Mr. George Dixon.

The Institution is a Team.

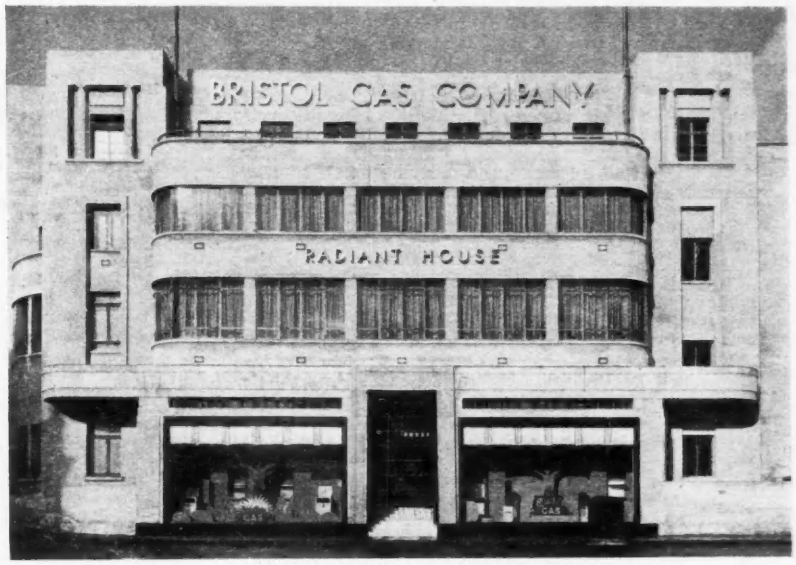
Mr. George Dixon, B.Eng., M.Inst.C.E. (President-Elect), responding, said that, as President of the Institution of Civil Engineers, Mr. Binnie ruled over some 12,500 members, more than seven times the number in The Institution of Gas Engineers. But gas engineers were not jealous in that respect; they believed that their strength and their success lay in the fact that they were able to maintain close personal touch with the members. Their work comprised every branch of engineering. No member was a master of all, but the Institution was a team, every member contributing to the common good, and the results of all work were made available immediately to all. The Council controlled a number of standing committees, and the Research Committee was split up into a number of sub-committees, which maintained close touch with work in all parts of the country. The district associations were strong and active and were all affiliated to the parent body, which watched their progress with considerable interest and pride. Finally, they had a body of 1,800 members in the junior associations, all linked up in the Joint Junior Council.

Quite apart from commercial considerations, they believed they were doing a work of national economic importance, and they did not regard their mission lightly. Indeed, at the present time, when they were celebrating the centenary of the work of William Murdoch, the founder of the Industry, there was a greater urge than ever to prosecute research, and the Institution was planning in order that no opportunity should be missed of gaining knowledge of the Industry's problems. The work was hard, but it was compensatingly fascinating, and in it they were proud to have the cooperation of so large a body of workers both in this country and abroad. Their relationships with professional friends on the Continent brought them together in such a way that it was difficult to understand why some countries were allowed to drift apart because of politics or jealousies about matters which were certainly not worthy of the distress that resulted. If, however, insanity prevailed, let it be understood that the British Gas Industry would muster all the forces at its command and place them at the disposal of the country they had the honour to serve.

Mr. G. H. Boucher (Chairman of the Bristol Gas Company), proposed the health of the President, and said that if Mr. Robertson had during his year of office as President established the same amount of respect as he had established over a long period of years among those with whom he came into contact in Bristol, he was indeed popular.

The **President** briefly expressed his thanks.

WE give in the following article a few notes on the various activities of the President's Company to which the members and their ladies were introduced on Friday of Institution Week.



The Bristol Company Entertains the Institution

Early Days.

COAL gas as an illuminant was introduced in Bristol as far back as 1811, when Mr. John Breillat, of Broadmead, a dyer by trade, employed the new method for lighting his shop and a portion of the street in which it was situated, and also gave lectures on the subject. As an outcome, a syndicate was formed under the name of "The Bristol Coal Gas Company," with a capital of £5,000—though some difficulty was experienced in raising even this modest sum. Mr. Breillat was appointed Manager, which position he retained until his death in 1856.

It was not until 1816 that the Bristol Gas Company began operations, the sum of £1,000 having been spent on works and mains, the latter being laid as far as the centre of the city. Main-laying was not accomplished without considerable opposition at first from the Corporation—the Court of Aldermen expressing grave apprehensions of danger from the proximity of "Aladdin," and the first gasholder at Temple Backs was not inappropriately named, to the city gunpowder depot at Tower Harritz. Indeed, they "considered it their imperative duty to withhold any measures being taken in the streets while the gasometer was in its present position." The obstacle, however, was eventually overcome, and shops and streets were beginning to be lighted by gas in 1817 and 1818.

In 1823 a rival company was formed in the Bristol and Clifton Oil Gas Company—for the production and supply of "inflammable air or gas" manufactured from oil and any other material (except coal, coke, and other products or residuum of coal). Their works were situated at Canons Marsh—the works visited by the members of the Institution—and the price of their gas was 40s. per 1,000 cu.ft.; nevertheless, the light was claimed to be four times as brilliant as that from coal gas. Unfortunately, however, the price of oil went up, and the Company were unable to pay a dividend. So they applied to Parliament for power to use coal. In 1853 the two undertakings amalgamated under the style of the "Bristol United Gas Light Company." The Stapleton Road Works were erected in 1879 to meet the increasing demand for gas, while the Chief Offices were removed from Canons Marsh to Colston Street in 1907.

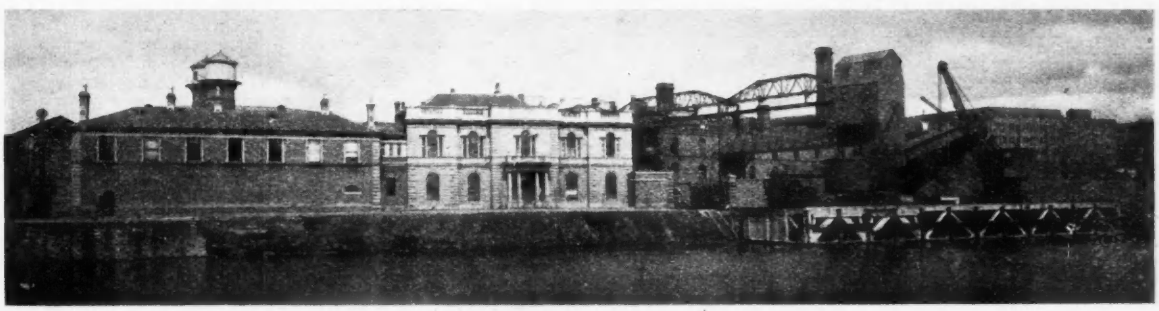
The Works.

THE Bristol Gas Company have three manufacturing stations as follows:

Avon Street	..	4 million cu.ft. per day coal gas (horizontal retorts). 3 million cu.ft. per day C.W. gas.
Canons Marsh	..	4 million cu.ft. per day coal gas (horizontal retorts). 3 million cu.ft. per day C.W. gas (automatic control).
Stapleton Road	..	5½ million cu.ft. per day coal gas (continuous vertical retorts). 3½ million cu ft. per day coal gas (horizontal retorts).

We will confine our description, however, to the works visited by the Institution—namely, Canons Marsh. These works are situated on the waterside, coal being delivered by both water and rail. Colliers of 150 tons capacity bring coal from South Wales, while boats of 2,000 tons come from Durham. The coal-handling plant consists of grab cranes, telphers equipped with auto-weighers wagon tippler, crushers, bucket elevators, and push-plate conveyors.

There are two retort houses, each containing one branch of ninety horizontal retorts 24 in. by 18 in. by 20 ft. long, equipped with Drakes charging machines. A third house has a bench of



The Canons Marsh Works from Across the Water.

ninety retorts 20 in. by 15 in. by 18 ft. long, equipped with a de Brouwer charging-discharging machine.

Coke-handling plant consists of de Brouwer hot coke conveyors in front of each bench, delivering over jigging screens into skips and thence by electric crane to storage yard, C.W.G. plant, or grading plant. The last-named has a capacity of twenty-five tons per hour and is arranged for loading conveniently into either road or rail vehicles.

Condensers are of the atmospheric type, both horizontal and vertical. There are three sets of two-blade exhausters, each of 125,000 cu.ft. per hour capacity. Ammonia recovery plant consists of two tower scrubbers and two rotary washers in parallel. There is one set of four cast-iron purifiers, with Weck type centre valve, together with one set of two ferro-concrete boxes used as catch boxes. Both sets are overhead, and oxide-handling plant consists of bucket elevators and push-plate conveyors. A Holmes benzole plant operates on the purified coal gas with gas oil as the washing medium. There are two station meters of 100,000 cu.ft. per hour capacity each.

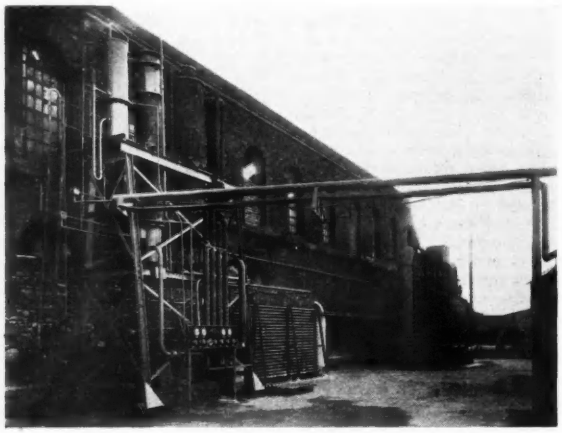
C.W.G. Plant.

THE carburetted water gas plant is of two units, each of 1,500,000 cu.ft. per day capacity, with automatic operation and feeding and clinkering equipment, and also waste-heat boilers. The blowers are in duplicate and driven by de Laval steam turbines. Oil is delivered by barge into two steel tanks each of 120,000 gallons capacity.

There are three water gas condensers of the water-tube type and also a single-lift relief holder with steel tank, 70,000 cu.ft. capacity. The exhausters consist of three sets of two-blade machines, each of 50,000 cu.ft. per hour capacity. Tar extractors are of the P. & A. and Livesey types. The water gas purifiers comprise two sets of four overhead cast-iron boxes with Pickering centre valves. There is one standard type 100,000 cu.ft. per hour meter, together with a Kent shunt meter of 120,000 cu.ft. per hour connected to work in series or in parallel with the other. The naphthalene washer is of the rotary brush type, gas oil being the washing medium.

The storage capacity at the Canons Marsh works amounts to 1,210,000 cu.ft., comprising one spiral and two guide-framed holders. On the outlet of the holders is a Holmes "Dri-Gas" plant.

There is one set of two 350,000 cu.ft. per hour steam turbo blowers for boosting district pressures up to 12 in., together with one Connersville booster of 150,000 cu.ft. per hour for transferring gas to other stations or district holders at pressures up to 80 in.



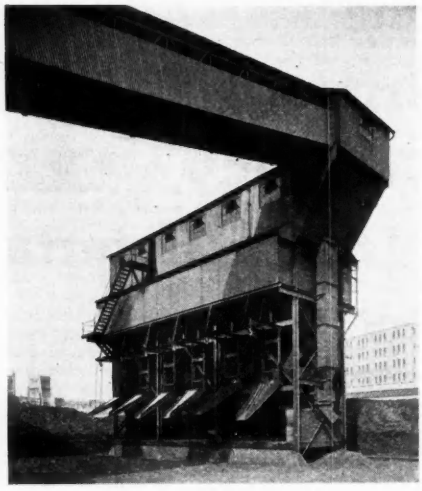
Benzole Recovery Plant.

As standby there is a further turbo blower of 120,000 cu.ft. capacity. Steam plant consists, in addition to the C.W.G. plant waste-heat boilers, of three Lancashire boilers, equipped with forced draught for burning breeze fuel. The plant is provided with water softeners, the feed water being heated by exhaust steam. The electric power plant consists of two 35 kW generators driven direct by gas engines and two sets of 80 kW motor generators for utilizing Corporation supply. The central chemical laboratory is situated at these works, while a further interesting feature is a small test works consisting of two settings of five retorts 20 in. by 15 in. by 18 ft. long, with complete equipment for purifying, measuring, and testing the gas. There are also blacksmith's and carpenters' shops for carrying out routine works repairs.

Distribution and Sales Organization.

THERE is no need to refer here to these aspects of the Bristol Company's activities, as the subjects are dealt with in Mr. N. S. Smith's Paper to the Institution, with a description of the extent to which co-operation has been developed between other public utilities, builders, and allied traders.

No account of the Company's activities would be complete, however, without reference to their very fine showrooms and central offices and their highly-developed Home Service side. Bristol and Home Service are almost synonymous terms, and this branch of the Company's organization is tackled with a thoroughness and attention to detail which renders them almost unique. The guiding principle of their policy is to develop personal contact with as many of their 120,000 consumers as practicable; and, judging by the parties who may be seen going round the showrooms at almost any hour of the day, there can be few who have not contacted with the Company at some time or other in this way.



Coke-Grading Plant.

At the present time the Home Service staff includes seven qualified demonstrators and two expert organizers, while the demonstration room can accommodate a hundred people in comfort. In addition to these "inside" demonstrations, however, the Company hold regular demonstrations in the nearby Little Theatre, when audiences of 400 and more are generally the rule. It is appreciated, of course, that, valuable as such demonstrations are, they can only touch but the fringe of the consumers in so large a city; the Home Service organizers therefore contact systematically with all the many women's clubs and societies and arrange demonstrations, lectures, and showroom visits specially for their members, and so wide is the extent of their activities the Company's programme in this connexion is always booked up months in advance.

In addition to these demonstrations, the Company make a point of offering their services at centres for the poorer classes of the community, where advice is given on the cheapest methods of providing and cooking nourishing meals; and at the end of these demonstrations the food which has been prepared is raffled. Evening classes are specially arranged for business girls and those about to get married in order to provide them with a background of useful domestic knowledge for the time when they will be running their own homes.

Each year many hundreds of parties of women are conducted round the showrooms, and that such visits are highly appreciated is indicated by the fact that individual consumers often arrange with the Company for parties of their personal friends to tour the premises. Such visits give those participating an insight into the wide ramifications of the Home Service section and the many ways in which it can assist the individual consumer.

Radiant House.

THE spirit of the Bristol showrooms is predominantly one of welcome. The whole premises hum with activity; there is an enthusiasm about each member of the staff and every sign of keen interest and appreciation on the part of all those whose business takes them into the building. Visitors receive a salute and a bright "Good morning" from the two smart pageboys at the door, and the same feeling of cordiality is evident throughout. The Company makes a point of cultivating this

atmosphere of friendliness and helpfulness to all who come to the showrooms, while they encourage consumers to make the premises a popular rendezvous in the town. As a meeting-place the showroom is, of course, ideal; the public can sit in comfortable chairs, surrounded by the latest types of gas appliances in attractive settings. They are not worried to buy; they may wander round at their leisure if they wish—though there is always a member of the staff at hand to explain any point of interest.

For a full account of the Bristol Company's magnificent showrooms and offices we would refer our readers to the illustrated description which we published in the "JOURNAL" for April 3, 1935, on the occasion of the official opening. To recall to the members of the Institution a few impressions of the many delightful features of the building which they saw last week, we would, however, just mention one or two of the principal points of interest.

The building has a frontage of approximately 100 ft. and a depth of approximately 180 ft. The front is constructed of selected Portland stone, while the side walls are built of Bath stone. The name of the Company at the top of the building is composed of letters 3 ft. high, made of lead covered metal cellulosed, inlaid with Staybrite strips, and floodlighted at night.

The two showroom windows are each 20 ft. long and 7 ft. 6 in. deep, and are semi-enclosed. The frames are of bronze metal, while the lettering above the windows is also in bronze and is illuminated from behind the letters.

Window displays are changed approximately every ten days, and it is worthy of mention that windows are frequently loaned to local charitable organizations for propaganda displays.

Passing beneath the portcullis gate guarding the main entrance the visitor is at once impressed with the beautiful colourings of the marble and tiles forming the entrance hall. Smart pageboys open the doors which give access to the lounge showroom. The walls of this room are in plain plaster, finished a cream colour, with ceilings of light green. The columns are in terra-cotta shade of red, with green and gold caps. The floor is of Traventine marble. Comfortable settees and chairs tempt one to stop and admire the handsome lighting fittings, the Adam fireplace, or the beautiful panel fires and enamel cookers which surround the walls. At one end of this room two steps lead to the lift and staircase. The main saloon is reached by passing through the lounge. The walls of this room are panelled in oak and walnut veneers to give a more intimate character to the exhibits, which are mainly gas fires. The floor, like the lounge, is of Travertine marble.

A Glimpse of the Basement Showroom.

The bathroom display, leading off this room, with its glass walls, marble and tile floor, coloured baths and wash basins, supplied with hot water from chromium geysers, will appeal to all visitors. Beyond the main saloon and entered through it is the Rental Hall for the payment of accounts, dealing with enquiries, &c. The public space in front of the counter is arranged under a series of plaster domes with centre lights, and with a floor of Travertine marble.

The Lower Showrooms.

THE lower showrooms are reached by the lift or staircase from the lounge. The exhibits are arranged in a series of tiled recesses with concealed lighting behind glass soffits, the effect being to concentrate the light on the appliances. The principle is the same as in the lighting of a modern aquarium. The floors are of Terrazzo, laid out in squares. The first of these rooms displays hotel equipment and coke fires. The second consists of all types of water heaters, enamelled cookers, refrigerators, and gas fires. All the exhibits are working. The water heating displays, with heat indicators showing the temperatures of the water, are particularly impressive. The third showroom is of special interest to builders and shows the method of building in flue blocks in lieu of chimneys. This is also the room where one can choose the colour scheme of a new gas fire.

The first floor is utilized for the Board Room and Committee Room. The second floor contains the staff dining room, service room, and staff recreation rooms, and the third floor is used for the kitchen and service rooms.

A Display of Large-Scale Catering Equipment.

The interior of the building is light and cheerful, reliance being placed on good materials and clean bright colours, rather than on decorative features as such.

In addition to gas fires, the general heating is by means of a low-pressure hot water installation, supplied by a cast-iron sectional coke boiler. Full regard has been paid to the comfort of the public visiting this building. The atmospheric conditions are efficiently dealt with by an air-conditioning installation, capable of handling 14 tons of fresh air per hour.

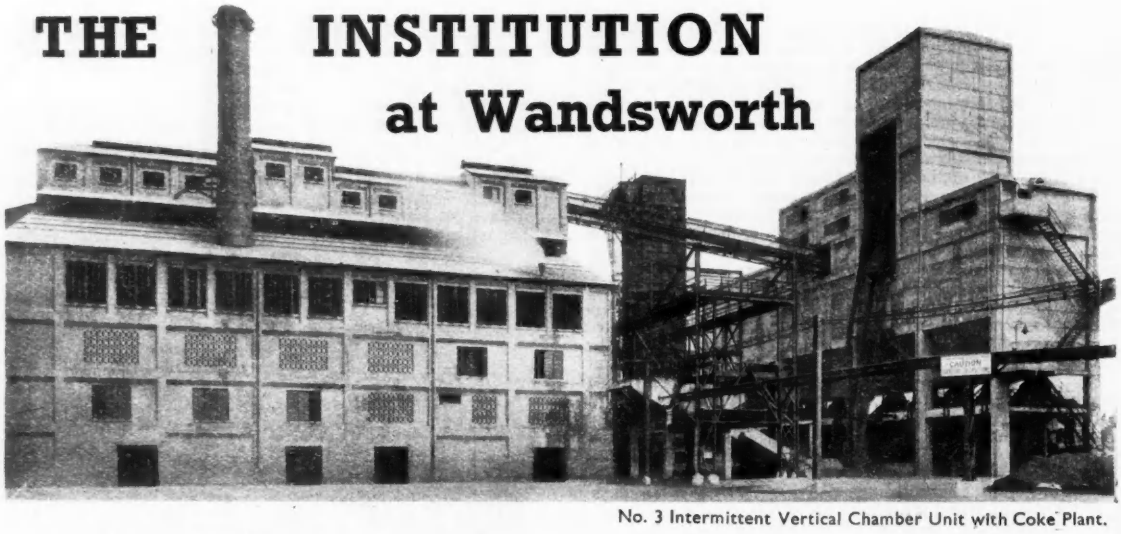
A FEW STATISTICS RELATING TO THE BRISTOL GAS COMPANY

Declared calorific value		480 B.Th.U.
Price of gas		8d. per therm, subject to discount for quantity consumed.
Total manufacturing capacity		23,000,000 cu.ft. per day
Total storage capacity		18,000,000 cu.ft.
Total gas sold—		
1918		3,017,000,000 cu.ft.
1938		4,158,000,000 cu.ft.
Maximum day's sale of gas—		
1918		13,868,000 cu.ft.
1938		19,500,000 cu.ft.
Maximum week's sale of gas—		
1918		87,500,000 cu.ft.
1938		128,500,000 cu.ft.

	1918.	1938.
Number of ordinary consumers	36,214	55,558
" " prepayment "	32,870	77,633
Total	69,084	133,191

Total length of mains—	
1918	380 miles
1938	659 miles
Cookers issued—	
1918	58,689
1938	113,297

THE INSTITUTION at Wandsworth



No. 3 Intermittent Vertical Chamber Unit with Coke Plant.

On Thursday afternoon members of the Institution were entertained by the Wandsworth and District Gas Company, when two most interesting visits were made. While one party toured the Wandsworth Works and saw, among other things, the installation of tower purifiers which was the subject of Mr. C. M. Croft's Paper, another inspected the Company's Re-Distribution Station at Worcester Park, the drive down taking the visitors over Epsom Downs.

THE WANDSWORTH WORKS.

THE Wandsworth Gas-Works have previously been described in the "JOURNAL," but the following particulars will serve to remind members of the Institution of some of the many interesting features they saw at the works. The Wandsworth Works, capable of producing 22 million cu.ft. of gas per day are the largest of the Wandsworth and District Gas Company's six manufacturing Stations and supply 70% of the total gas requirements in the Company's area.

The Works were established in the year 1834, and are situated on the south bank of the River Thames in the vicinity of Wandsworth Bridge. The original plant was built on less than an acre of ground; to-day the Works occupy some 28 acres and have about one-third of a mile of river frontage.

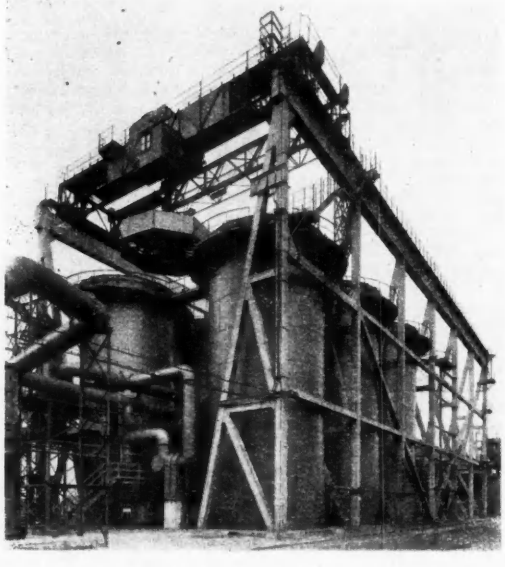
The whole of the coal requirements of the Company, amounting to 450,000 tons per annum, is delivered at Wandsworth by four sea-going colliers—the largest being the s.s. "Wimbledon," which carries approximately 2,500 tons. These ships, owned and managed by the Company, are of particular interest, being designed specially to navigate the River Thames and pass under the 17 bridges encountered on the voyage to Wandsworth.

To deal with the continually increasing tonnage handled, a coal discharging jetty was built in 1934. The jetty, a reinforced concrete structure, erected almost in mid-stream, provides facilities for the speedy discharge of the Company's ships. This plant embraces two hydraulically operated travelling cranes and reinforced concrete hoppers, having a capacity of 1,200 tons. The cranes are fitted with grabs of 5 tons capacity, each capable of discharging 200 tons per hour. The coal is discharged from the ships into the hoppers whence it is carried by a 48 in. rubber belt conveyor to a steel bunker on the shore. At this point the coal stream is divided and by conveyors is transferred either to No. 3 retort house and the main coal stores, or directly into No. 2 retort house service stores.

There is storage at the Wandsworth Works for 60,000 tons of coal, which is equivalent to eight weeks' requirements when the carbonizing plant is operating at full capacity.

Gas Producing Plant.

THE gas producing plant at Wandsworth consists of intermittent vertical chamber ovens, horizontal retort settings, and carburetted water gas plant. Nos. 1 and 2 batteries of intermittent vertical chambers have 66 vertical chambers of 3½ tons capacity, arranged in two units of 30 and 36 chambers respectively, been designed to produce 6½ million cu.ft. of gas when carbonizing 460 tons of coal per day. The normal carbonizing period is twelve hours, the charge being steamed during the last three hours. The chambers are arranged in units of six, heated by gas obtained from an equal number of internal step-grate producers. The fuel used consists of "scalpings," which is the coke residue falling through a screen with 1¾ in. perforations. The chambers are discharged into specially designed "buses" propelled by electric locomotives; constant and careful attention is given in quenching to ensure that the moisture content is maintained at a low figure.



Tower Purifying Plant showing Overhead Crane lifting Oxide Tray.

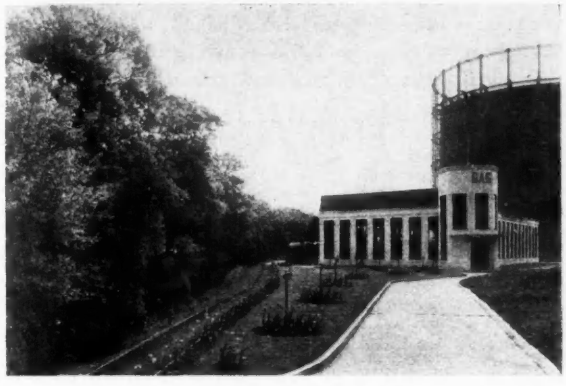
An interesting feature in the construction of the benches is the system of bracing, which is kept in a state of constant tension by means of spring-loaded buckstays and tubular water-cooled tie-rods. The water from these tie-rods is passed to two waste-heat boilers, which generate 14,000 lb. of steam per hour.

An additional unit of 36 vertical chambers (No. 3 Battery), with a daily coal throughput of 266 tons and producing 4 million

cu.ft. of gas, has been put to work recently. This plant is of the non-recuperative type, and the chambers are heated by gas from an external battery of six step-grate producers, so arranged that any one may be shut off independently without affecting the normal working of the plant. A waste-heat boiler generating 16,000 lb. of steam per hour at a pressure of 190 lb. per sq.in. is installed.

There are 36 settings, each of ten 16 in. by 24 in. horizontal retorts of round bottom D section, 23 ft. long, in three separate retort houses having twelve settings in each. The daily throughput of coal for the whole plant is 550 tons, producing 7½ million cu.ft. of gas. The settings are fitted with anti-dip pipes. The stoking machinery employed is of the charger-discharger type, electrically operated. A waste-heat boiler which generates 6,000 lb. of steam per hour is installed in No. 2 retort house.

Two units of carburetted water gas plant each produce 2¼ million cu.ft. of gas per day, using the three-phase cycle back-run process. They are provided with mechanical ash and clinker extractors, and the coke, obtained from overhead storage bunkers,



Worcester Park Re-Distribution Station.

is screened before being fed into the generators by hydraulically operated chargers. The equipment also includes duplicated steam driven exhausters and blowing fans driven by geared steam turbines.

Control Room.

FIVE of the six retort houses are served by No. 1 exhauster house, and in order to provide for the individual vacuum requirements of each house the several gas streams are led to a reception box where a vacuum is maintained slightly greater than that required in the retort houses. The vacuum of each stream is regulated by governors to meet the prevailing conditions of the house to which it is connected. Continuous samples of each gas stream are drawn off by miniature exhausters and after purification are passed through a recording calorimeter; thus, the control room attendant has constant knowledge of the quality of gas being made in each retort house.

The Tower Purifiers.

PARTICULAR interest was evinced by the members in the new installation of tower purifiers. These are fully described in Mr. C. M. Croft's Paper to the Institution, brief details being as follows. The plant, which is the first of its kind in this country, has a nominal capacity of 10 million cu.ft. of gas per day, and consists of a battery of six cylindrical towers approximately 52 ft. high and 22 ft. in diameter. Each tower accommodates twelve movable containers, which carry a total weight of 300 tons of 30:70 Lux/Bog Ore mixture. An interesting feature is the electrically driven crane, which, supported on a reinforced concrete gantry, is used to raise the containers, each weighing about 35 tons.

The benzole recovery plant was installed in 1934, and is capable of recovering 3,000 gallons per day of "once run" benzole. While the control of the plant is practically automatic, all requisite instruments are arranged on a panel situated inside the control house.

An interesting installation at these Works is the provision of boosters at the outlet of the purifying plant, their function being to reduce the back pressure on the plant at times of heavy loads. They are designed to be able to take varying pressures up to the maximum required to lift the holders, thus relieving the purifying plant of a considerable amount of resistance. They comprise two units rated at 500,000 cu.ft. and 750,000 cu.ft. per hour respectively.

There are four holders for coal gas and one for carburetted water gas, the former having a total capacity of 4,157,000 cu.ft. and the latter 86,000 cu.ft. Gas is transferred in bulk from the Wandsworth Works through trunk mains to the Mitcham, Kingston, Epsom, and Leatherhead Works of the Company, as well as to the Worcester Park Re-Distribution Station, which was also visited by members of the Institution.

Power Plant.

THE centralized steam raising plant comprises two water tube boilers, each evaporating 25,000 lb. of water per hour, and one water tube boiler evaporating 43,000 lb. per hour. These boilers, which work at a pressure of 180 lb. per sq.in., were designed for burning breeze and are equipped with gravity-fed chain-grate stokers. Five sets of steam driven generators, with a total of output of 2,000 kW, installed in a central power house, provide sufficient power with adequate reserve for all requirements on the Works, while two rotary converters, housed in a separate building, are used for standby purposes.

A vertical two-stage compressor able to compress 600 cu.ft. of free air per minute to a pressure of 160 lb. per sq.in., is used for pumping water from two Artesian wells. These two wells are each 630 ft. deep and are of 7½ in. and 24 in. diameter respectively. Water is also drawn from the River Thames and treated in a pressure filtration plant, consisting of eight filters with a total capacity of 80,000 gallons per hour. The filters are contained in four elliptical drums, each filter bed being 8 ft. wide by 3 ft. deep. The beds are cleansed at regular intervals by agitation with compressed air accompanied by a reversed flow of filtered water.

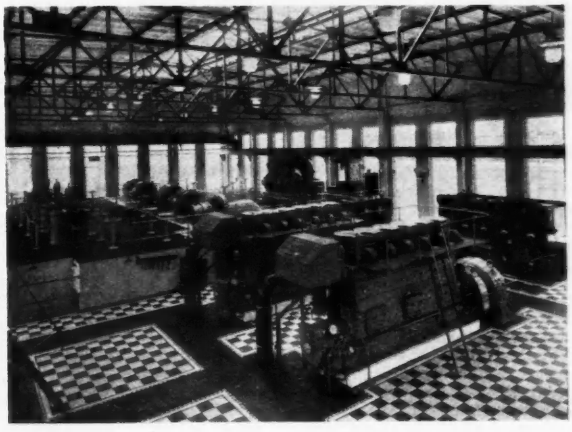
Magnetic Ash Plant.

THE clinker, ash, and coke withdrawn from the producers of the carbonizing plant are treated in a magnetic ash separating plant. This consists of a feeding hopper, elevator, and revolving screen. Below the screen are hoppers and chutes through which the graded material passes to the magnetic drum separator. Separation of the combustible and incombustible material is effected by the attraction of the clinker, &c., to the magnetic drums.

Machine and fittings shops are equipped with machinery and tools carrying out all major mechanical repairs. There are also blacksmiths' and carpenters' shops, electricians' workshop, and general mechanical stores; adjoining the building is the brass foundry, where castings up to 100 lb. can be made.

WORCESTER PARK RE-DISTRIBUTION STATION.

WHILE one party of members were inspecting the Wandsworth Gas-Works, a further party visited the Worcester Park Re-Distribution Station. This Station, which has two holders with a total capacity of 4,666,000 cu.ft., is equipped with boosting and governing plant, enabling gas to be distributed to all outlying areas of the Company.



Worcester Park—Interior of Governor and Booster House.

The building in which the plant is housed consists of a steel framing with reinforced concrete panels and large steel windows giving ample natural lighting, while a mansard roof with louvre ventilators at the peak provides adequate ventilation. There is a basement in one half of the building, through which all gas connexions enter and leave at their normal underground level. These

connexions and valves have machined faced flanges and joints made with Taylor rings, and are 24 in., 30 in., and 36 in. in diameter. The use of this type of joint has enabled these connexions to be confined to a very small area, thus reducing the capital cost.

On a stage approximately 4 ft. above the floor level are mounted the boosters, a 24-in. meter measuring the gas entering the building, four 24-in. pressure loaded station governors controlling the distribution pressures, and all the valve operating pedestals. The high-pressure boosters are in duplicate, and are two-stage machines with increasing-speed gears, each capable of handling 400,000 cu.ft. of gas per hour at 5 lb. per sq.in. pressure. The gearing is direct coupled to a 210 h.p. motor with a speed of 800-1,000 r.p.m. The low-pressure booster is capable of handling 500,000 cu.ft. of gas per hour at a pressure difference of 12 in. w.g.

To supply the current for the boosters, two generating sets have been installed, each consisting of 330 h.p. 6-cylinder Diesel engines direct-coupled to 200kW 220 volt direct-current dynamos.

Duplicate circulating pumps for engine cooling are installed, and a cooling tower is situated outside the building; while for starting purposes, one gas-engine-driven and one motor-driven air compressor have been provided, together with air receivers.

A Visit to the Luton Works

of the Davis Gas Stove Company

On Wednesday afternoon one of the visits was by invitation of the Davis Gas Stove Company (Radiation Limited) to their Luton Works and Foundry.

The President of the Institution is welcomed by Mr. Cyril Davis.

THE original Davis firm was founded in 1873 by the late Henry and Charles Davis, as part of the existing firm of H. & C. Davis & Co., Ltd. In 1891 the Davis Gas Stove Company, Ltd., was formed with its works at Camberwell, London. Subsequently works were started at Luton in 1895 and then at Falkirk in 1900. In the year 1906, all the works were centralized on the present site, under the direction of the late Mr. Harold Davis. Finally, in 1919, the Company associated itself as an original member of Radiation Ltd. It manufactures castings and pressings to the Trade, in addition to a full range of gas appliances.

Upwards of 2,000 employees are on the normal average pay-roll of the Company, and the works cover an area of nearly 20 acres.

The Company has a flourishing Social Club run by the workers themselves, and besides dining rooms and an indoor club they have two hard tennis courts, a superb bowling green, and a sports field with cricket and football grounds. In common with the associated Radiation Firms an insurance and pensions scheme provides for the staff on retirement, and all the workers receive holidays with pay.

A whole-time officer in charge of A.R.P. has been appointed, and the protection of the workpeople in time of war has been fully secured by the Company.

Arriving by car or coach from Gas Industry House, the visitors were received by Mr. Cyril G. Davis, Chairman of the Company, and Mr. Kenneth N. Davis, the Managing Director, who were supported by Mr. J. Ivan Yates, a Director of Radiation Ltd., Mr. James H. Kemp, Chairman of Fletcher, Russell, & Co., Ltd., and Mr. Robert Poole, Managing Director of Richmonds Gas Stove Company.

The most efficient arrangements which had been made for the tour of the works permitted easy modification owing to the exceedingly hot weather, but everyone was enabled to gain an insight into the main processes which go to produce the highly specialized gas appliances of to-day. The various departments were visited in the order that the appliances themselves follow in course of manufacture.

Passing through the Chemical Laboratory and Pattern Department, the visitors found much of absorbing interest in the Floor Foundry and Mechanical Moulding Department. This foundry for light castings is one of the largest under one roof in Great Britain; and the mechanical foundry, where the boxes are taken for a kind of "scenic railway" ride on a continuous belt, is a remarkable example of modern mass production. The moulds start their career empty, are packed and pressed mechanically, "poured" from small pots while actually on the conveyor line, and finally shaken loose ready for the various parts—several from each mould—to be sorted for the fettling shop.

The castings are remarkably clean, and we are informed that the percentage of wasters is extremely low. The plant is put in work for any large repetition order, while smaller casting batches are dealt with ordinarily on the floor of the foundry.

The visitors then passed through the tool room and machine department to the Assembly Department where note was made of the organization, directed to ensure not only extreme accuracy of fitting but the smooth and rapid passage of all apparatus towards the Despatching Warehouse.

The Enamelling Department amounts to a works within a works, where every process is carried out from the mixing and testing of the raw materials to the varied finishes for which Radiation reputation stands so high.

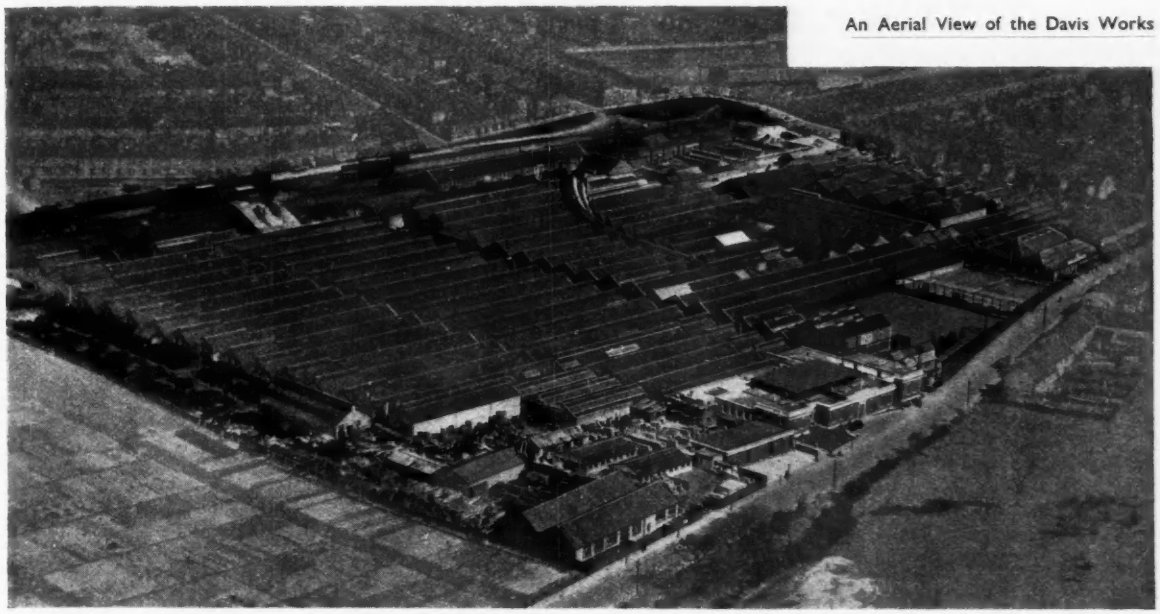
A covered railway siding lies alongside the despatch yard, whence a regular service of lorries leaves to convey Davis Stove Company products to all parts of this country and for shipment overseas.

After the tour the visitors made their way to the Social Club, where each one received a souvenir of a most interesting day—for the ladies posies of carnations, for the men a "Rototherm" thermometer in a setting which had been produced by the Firm.

A vote of thanks to the Directors and Staff of the Davis Gas Stove Company was proposed by Mr. Robertson, who said how much the Institution appreciated the opportunity of visiting this up-to-date Works and their final hospitality in the Club.

In reply, Mr. Cyril Davis expressed the Firm's gratification

A Machine Shop at the Luton Works.



An Aerial View of the Davis Works

at the large turn-out of members. They were specially glad to be able to welcome so many ladies—on a very hot day when they might well have preferred the alternative visit to Windsor. He referred to the desirability of manufacturers standardizing their products as far as possible, and to the great difficulties they met in effecting this. Small and apparently unimportant variations in their products added greatly to the cost of production. Such a visit as this would bring about a keener appreciation of these small idiosyncrasies and the difficulties to which they gave rise.

Before the visitors left they had an opportunity of inspecting test models of two new Radiation gas fires, which were demonstrated by Dr. H. Hartley, Chief Radiation Chemist.

At the Osram Lamp and Glass Works

On Wednesday afternoon a visit was paid to the Osram Lamp and Glass Works of the General Electric Company, Ltd., at Wembley.

The General Electric Company is one of the largest industrial consumers of gas in the Gas Light and Coke Company's area. Except for a few processes for which electricity or oil has been found for special reasons to be more suitable, gas is employed as the heating medium at almost every stage of production throughout the works, from the drawing of molten glass into tubes to the final soldering on the caps of the bulbs. The Wembley works, one of the biggest of its kind in the world, makes its own glass, produces its own metals and alloys from crude ores, makes and prints its own cartons, and turns out lamps ranging from the pocket flash lamp variety to the 10 kW lighting unit for aerodrome lighting.

Beyond the production of the glass bulbs and tubing, the preparation of the metals and the winding of the coils, the making of lamps involves the flanging of the inside tubes, mounting the wires, and coils, sealing the assembly within the bulb, exhausting the air and, where necessary, filling with argon gas, and the final capping, soldering, and packing, each stage being accompanied by scrupulous testing and examination.

In the glass tube drawing department, molten glass, maintained at the required temperature by gas flames, pours from the furnace on to a rotating mandrel through which air is blown. The tube is drawn from the end, the size varying according to the speed of drawing, air pressure and flow of glass. Flanging is done on duplex flanging machines, in each of which twenty lengths of glass tubing at a time are inserted. The machines are fitted with finely adjusted gas burners which melt the tubes for the making of the flange. Definite lengths are cut off in a gas flame and the cycle of operations is repeated twice in each rotation, each machine producing 2,760 flanges per hour.

The mounting machines successively flatten and hook the ends of the lead wires, clamp on a filament, form, by means of gas burners, a glass stud and insert supports, loop the supports round the filament and shape the finished mount at 1,200 an hour. Two workers nowadays produce as much as ten did ten years ago, or over 50, years ago. The latest production of the Osram Works machine development department is the combined sealing-in and exhaust machine, sealing-in and pumping lamps at 1,500 an hour. Gas is employed for the sealing-in, and mechanical "hands" are used for loading, transferring, and unloading. There are equivalent gas-heated sealing-in and exhaust machines for flash lamps, which load bulbs and filaments from trays and seal on exhaust tubes, transfer to the exhaust machine and pump 1,450 lamps an hour.

The flanging, pinching, mounting, combined sealing-in and exhausting, finishing, and packing machines are connected by conveyors, representing one of the most completely automatic working arrangements in England, and the plan will shortly be modified to suit improved sealing-in and exhaust machines now being evolved.

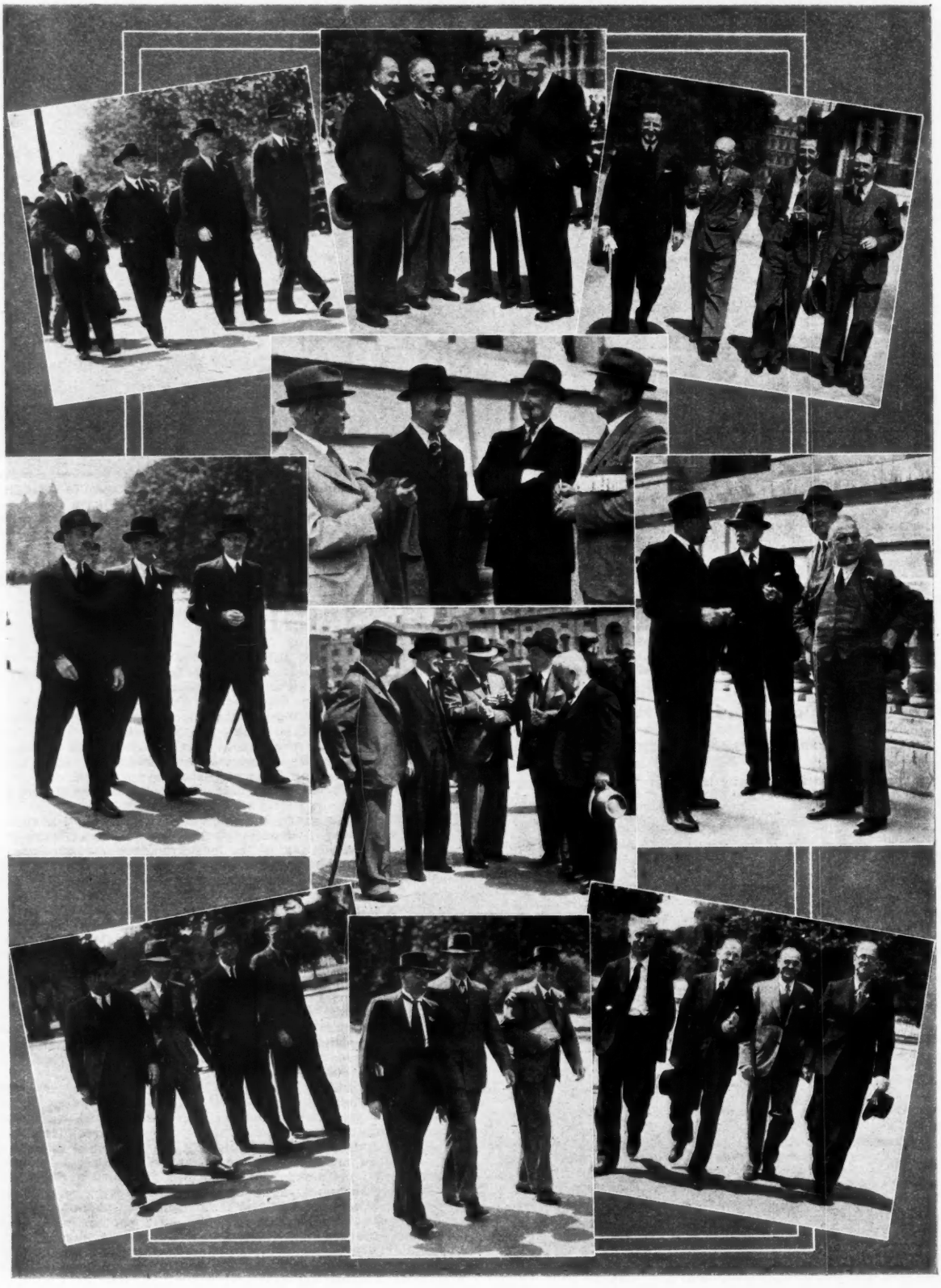
The beading and mounting machine for miniature lamps performs a whole series of operations almost unattended. It cuts off two lengths of wire, slips over and melts on a glass bead, flattens and hooks the wires, bends them to shape, coils a filament, cuts it, transfers it by mechanical fingers and clamps it into position, delivering the entire "inside" of a sidelight or flashlight at the rate of one every three seconds.

Bulbs from the bulb blowing department are unpacked and loaded on trays on to the bulb washing machine, which washes them with acid and hot water and dries them with hot air, finally passing them to the top floor for manufacture. Its capacity is about 15,000 bulbs per hour.

For "Sashalite" photoflash lamps, the bulbs internally lacquered to prevent cracking and filled with aluminium foil are sealed-in by gas, pumped and filled with oxygen. The filament is a short tungsten wire covered with a priming composition.

All the apparatus in the rating and quality control department was designed and built by the Osram Works or the Research Laboratories. Life and light output are controlled by high overload testing and photometry. A sample from every batch of filaments is made into lamps and the current consumption and light output measured directly on photo-electric photometers. They are then burnt on high overload racks at such a voltage, about 150% of normal, that they fail in a few hours. Their lives are automatically recorded, and accurately forecast the average life of the batch of filaments, which is released or rejected accordingly.

FURTHER SNAPS FROM THE MEETING



THE INSTITUTION

Benevolent Fund Meeting

The Annual General Meeting of the contributors to the Institution Benevolent Fund was held on Wednesday, June 7—Mr. ROBERT ROBERTSON presiding.

The **Secretary** (Dr. W. T. K. Braunholtz) read the Notice convening the Meeting, and the Minutes of the last General Meeting were read, confirmed, and signed.

The Committee's Report.

The **President,** in moving that the Report of the Committee of Management and the Accounts be received and adopted, said: In commending this resolution I may perhaps be permitted to add that a very special effort has been made during the past year to improve the revenues of the Benevolent Fund. The usual letters have been sent to all members, old and new, inviting subscriptions, enclosing Bankers' Orders, and recommending the signing of the covenant. In addition, a personal appeal has been sent to every member who is transferred to a higher class inviting him to increase his subscription to the fund.

An appeal has also been made to each of the Affiliated Gas Associations for local collaboration, and a special meeting of the Committee was held in April to which all Chairmen of District Associations were invited for the special purpose of considering means of enlisting the sympathy of non-contributing members. Already a number of the District Associations have appointed local Hon. Secretaries and arranged for local appeals to be made, and it is hoped that the more personal contact thus established may bear fruit.

The Committee has hitherto limited its expenditure to an amount approximately equal to the revenue received from subscriptions and interest on investments. Donations, which are more liable to fluctuate, have been earmarked for the reserve fund and invested as they accumulate. This has given to the balance-sheet an appearance of affluence which is perhaps misleading; and, after careful consideration, the Committee has decided to increase the scale of grants hitherto made to an extent which will absorb a considerable portion of the sum hitherto obtained as donations, and they hope that the response of members to the special appeal now being made will justify the step taken and that by another year it may be possible to increase still further the grants made. I can assure you that many of these are still far short of what the Committee would like them to be.

Sir Frederick J. West, C.B.E., J.P. (Vice-President of the Institution), seconding the motion for the adoption of the Report, said: I should like to refer to the observation inviting the members to enter into a Covenant to pay a definite subscription for seven years in order that we may recover income-tax. Only 91 out of many hundreds have indicated their willingness to enter into that Covenant, which is the easiest form of augmenting our income. It does not cost you anything more; there is merely the obligation to subscribe for seven years. It would add several hundreds of pounds to our income, however, and I hope that every member who has not yet signed the Covenant will do so, to enable us to go forward with the proper policy of increasing grants to deserving cases.

There was no response to the Chairman's invitation to the subscribers to discuss the Report, and the resolution for its adoption was carried.

Elections to Committee of Management.

Mr. E. Hardiker and Mr. James Taylor were elected by ballot to the Committee of Management.

Vote of Thanks.

Mr. P. N. Langford (Coventry) proposed a very hearty vote of thanks to the Chairman, Hon. Secretary, and Committee of Management of the Benevolent Fund. The work they had done would have given them far greater pleasure had they been able to give perhaps greater help to the many deserving cases which have come under their consideration. He trusted that the appeal which had been made, and to which the President has referred, would be very successful in its results. It would be indeed very fine if they could get something approaching 100% of the members of the Institution as contributors to this Fund.

Mr. A. S. Nisbet, seconding the vote of thanks, said he knew the officials of the Fund did their work well; it was self-effacing and self-rewarding. It was always a fine thing to help those to whom life had not been quite kind, and they should all be glad of the opportunity to relieve distress among some of their colleagues and their dependants.

The vote of thanks was carried with hearty acclamation, and the **President** having briefly responded the meeting closed.

New Members of the Institution

On Tuesday, June 6, the undermentioned were elected to Hon. Membership, Membership, Associate Membership, and Associateship of the Institution.

Honorary Membership.

The President (*ex officio*) of the International Gas Union and the Presidents (*ex officio*) of the Gas Associations of Australia, Belgium, Canada, Czechoslovakia, Denmark, France, Germany, Holland, Hungary, Italy, Japan, New Zealand, Norway, Poland, Spain, Sweden, Switzerland, United States of America, and Yugoslavia.

Membership.

Barash, Michael, M.Sc.Tech., Ph.D., F.I.C., Head of Research Department, West's Gas Improvement Company, Ltd., Manchester.

Bradley, George William James, F.I.C., Manager of Coke Oven Department, Grassmoor Company, Ltd., Chesterfield.

Cassan, J. H. F., Chief Engineer, Compagnie Générale de Construction de Fours, Paris.

Malsbury, Joseph, B.Sc., Works Engineer, Hertford Works, Tottenham and District Gas Company.

Platt, Harold, Chief Engineer and Manager, Bolton Corporation Gas Department.

Seylaz, Georges Edouard, Chief of Distribution and Gas Sales, San Paulo Gas Company, Ltd., Brazil.

Shann, Charles Douglas, M.A., Assistant Distributing Engineer, Gas Light and Coke Company.

Associate Membership.

Anderson, John Allan, Assistant Inspector, Edinburgh Corporation Gas Department.

Attwood, Albert William, Engineering Assistant, Coventry Corporation Gas Department.

Bain, Lewis, Chief Technical Assistant, Greenock Corporation Gas Department.

Baker, Eric Edward, Assistant Works Superintendent, Reading Gas Company.

Benstead, Thomas Willett, Junior Technical Assistant, Derby Gas Light and Coke Company.

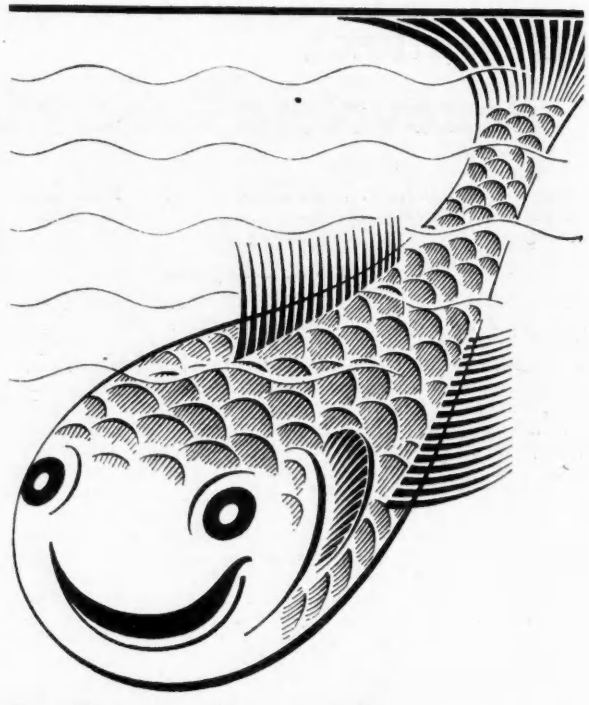
Bentley, George Alexander, Technical Assistant, Brighouse Corporation Gas Department.

Bremner, John Richard, Divisional Installation Supervisor, Gas Light and Coke Company.

Buckley, James Arthur, Staff Officer, Gas Light and Coke Company.
Clayton, Ronald Stafford, Junior Technical Assistant, Derby Gas Light and Coke Company.
De Quincey, William Bertram, B.A., Engineer and Manager, Cromer Gas Company.
Dougall, William, B.Sc., Technical Assistant, Plymouth and Stonehouse Gas Light and Coke Company.
Freshney, Charles Edward Norman, Assistant Engineer and Manager, Paisley Corporation Gas Department.
Gillies, Alexander, B.Sc., Assistant Coke Oven Manager, Grassmoor Company, Ltd., Chesterfield.
Grant, Arthur Frederick, B.Sc.Eng., Assistant Engineer, Gas Light and Coke Company.
Gunn, Alexander David Chalmers, B.Sc.Eng., Secretary and Executive Officer, Industrial Gas Development Centre, Leeds.
Hogg, John Capel, Chief Chemist and Technical Assistant, Stretford and District Gas Board.
Hogley, Charles Arthur, Assistant Works Chemist, Huddersfield Corporation Gas Department.
Horrod, Stanley Albert John, Junior Technical Assistant, Swindon United Gas Company.
John, Hywel, Operator, The Woodall-Duckham Companies, London.
Jones, Kenneth Edward, Draughtsman, City of Stoke-on-Trent Gas Department.
Kay, Charles, Chief Chemist, Bury Corporation Gas Department.
MacGregor, Kenneth, Operating Engineer, Simon-Carves, Ltd., Cheadle Heath.
Miles, Sidney Herbert, Technical Assistant, Reading Gas Company.
Morland, Roger, Industrial Gas Sales Engineer, Newcastle-upon-Tyne and Gateshead Gas Company.
Morris, Alexander, B.Sc., Chief Operating Engineer, Gas Chambers and Coke Ovens, Ltd., London.
Nachman, Ivan Denys, Technical Assistant, Slough Gas and Coke Company.
Preston, Will, Technical Assistant, Skipton Urban District Council Gas Department.
Priestley, James Joshua, M.Sc., General Senior Assistant, W. C. Holmes & Co., Ltd., Huddersfield.
Roberts, Leslie George, Technical Assistant, Tipton Urban District Council Gas Department.
Shillington, Thomas Foulkes, Junior Technical Assistant, Belfast Corporation Gas Department.
Smith, William John, Technical Assistant, Romford Gas Company.
Topping, James, Chemist, Carlisle Corporation Gas Department.
Westmacott, Michael Henry, Assistant Engineer, Ascot District Gas and Electricity Company.
Wilson, Raymond, Works Supervisor, Hardwick By-Product Company, Ltd., Chesterfield.
Yorke-Davies, Guy, B.A., Assistant Engineer, Gas Light and Coke Company.

Associateship.

Cohen, Hugh Thurston, Operating Engineer, Humphreys & Glasgow, Ltd., London.
Cook, George Raymond Thackray, Student, University of Leeds.
Darnbrough, James Frederick, A.M.Inst.C.E., Engineering Draughtsman, Birkenhead Corporation Gas Department.
Haynes, Arnold Simpson, Chief Chemist and Technical Assistant, Birkenhead Corporation Gas Department.
Higginbotham, Joseph, Director and Manager, John Ruscoe & Co., Ltd., Hyde.
Hoffert, Wilfred Herman, M.A., B.Sc., F.I.C., Chief Chemist, National Benzole Company, Ltd., London.
Metzgar, Spencer Churchill, Director and London Manager, Gibbons Brothers, Ltd., Dudley.
Noton, Clement Henry, M.Sc., Ph.D., Technical Adviser, London and Counties Coke Association.
Steel, Arnold Kirk, F.I.C., Consulting Chemist, National Benzole Company, Ltd.
Ward, Stacey George, M.Sc., Ph.D., D.I.C., A.R.C.S., Lecturer, University of Birmingham.



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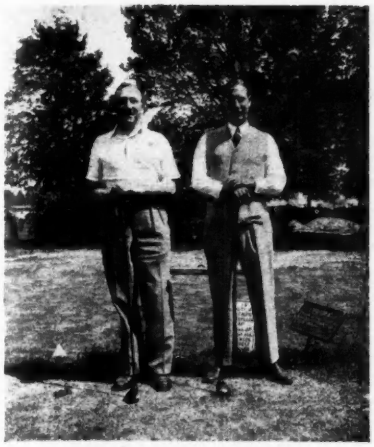


H. C. Smith with H. E. Bennet, Captain of the Circle.

The S.B.G.I. GOLFING CIRCLE

Spring Meeting

(For elucidation of the many points so admirably demonstrated, see any standard work on golf.)

J. Morland Fox, winner of the Thornton Victory Cup.

ACCORDING to custom, the Golfing Circle arranged their Spring Meeting for the first day of Institution Week, extending a cordial invitation to Institution members to attend and compete for the Coronation Plate—a perpetual trophy which the Circle presented in 1937 for annual competition on this occasion. Simultaneously members of the Circle competed for their own trophy—the Thornton Victory Cup. It was on assembly for the day's proceedings that many members heard for the first time of the sudden death on the previous day of the donor of this cup. Mr. H. M. Thornton will be sadly missed at the meetings of the Circle, of which he had been a staunch supporter.

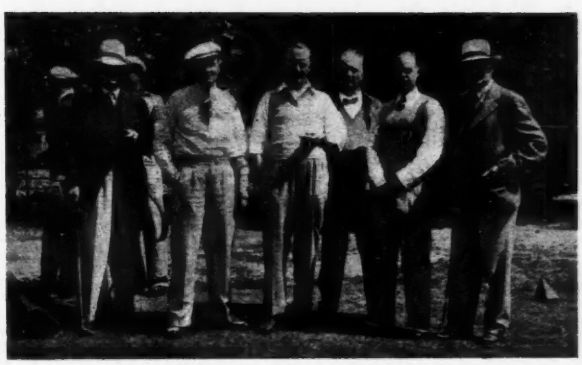
The famous course of the Royal Mid-Surrey Golf Club, in its beautiful surroundings on the borders of Kew Gardens, was looking its very best on a day of clear blue sky and brilliant sunshine. Fortunately for the players the heat was tempered by a stiffish breeze across the course, which did not, however, render any easier the finding of the closely guarded greens, however well the ball sat up on the perfectly kept fairways. The speed of the greens, too, after more than a fortnight of hot dry weather, was exceedingly puzzling to most of the field, and putts made up an unusually high proportion of most of the scores.

In spite of such worries, even those who tore up their cards or mutilated them in some other way were in the best of spirits at lunch time, and confessed to having had a grand morning, as the result of which the Thornton Cup went to W. Morland Fox, with a net score of 80, while the winner of the Coronation Plate, confined to Institution members, was won by T. C. Battersby, with 79 net.

The afternoon round consisted of foursomes against bogey for prizes presented by Mr. F. B. Holmes. As usual, with the courage engendered by a good luncheon, most of the players were more confident of beating their opponents than of lowering the Colonel's colours—possibly even keener to do so—and the arranging on the first tee of innumerable "corners" of a shilling or so disclosed many an old golf rivalry, besides adding to the excitement of the proceedings. In the end the winners of the prizes were T. C. Battersby and H. C. Dunbar, 1 down.

Mid-Surrey is famous for its hospitality to visitors, and everything possible was done for the comfort of the Circle members and their guests. Arrangements for the day were made, with his customary efficiency, by Mr. W. R. Edgar, Hon. Secretary and Treasurer, ably assisted by Mr. Brian Holmes. The Circle greatly appreciate the increasing acceptance by members of the Institution; from personal experience we can assure any who can possibly add to the numbers in subsequent years that this is an excellent day, and an admirable preparation for the sterner business of the rest of Institution Week. On this occasion two ex-Presidents were able to take part—Messrs. C. S. Shapley and Harold C. Smith; and the reigning President, Mr. Robert Robertson, very kindly undertook the giving of the prizes.

Our photographs of a few of the players show that many well-known golfers of the Industry were present. Mr. H. E. Bennet, the Captain, who partnered Mr. Harold C. Smith, recently drove himself into office of Golf Captain of the R.A.C. Country Club, Woodcote Park. Another evergreen partnership was renewed by the pairing-off of Messrs. J. Winson Scott and J. H. Kemp. Though unsuccessful this year, these hard-playing veterans will doubtless come up fighting on many future occasions.



News of the Week

New Offices are to be erected for the Doncaster Gas Department and application is being made to the Ministry of Health for sanction to a loan for this purpose.

First Prize was awarded to the Liverpool Gas Company for the best advertisement display (motor vehicle) in the Bootle May Day horse parade and motor carnival held on June 3.

The Central Administration of the United Kingdom Gas Corporation will be occupying fresh premises as from June 19. Their new address will be Bridgewater House, 60, Whitworth Street, Manchester, 1 (P.O. Box 513); telephone CENtral 7142 (5 lines).

For Approval by Resolution, drafts of the Special Orders for which application have been made to the Board of Trade under the Gas Undertakings Acts, 1920 to 1934, by the Maldon Gas Light Company and the Newton Abbot and District Gas and Coke Company, have been laid before both Houses of Parliament.

Very Successful Cookery Demonstrations were held at their showrooms by the Stockton-on-Tees Gas Department during the week commencing Monday, May 22. The demonstrator was Miss M. Harris, of Messrs. Sidney Flavel and Co., Ltd. These demonstrations were very well attended and were much appreciated, and good business resulted from the effort.

A New Bakery is being erected at St. Austell by Messrs. Eustace, Ltd., who are well known in Cornwall. The St. Austell Gas Company has secured an order for gas for all hot water and heating of the premises. This load is expected to amount to three-quarters of a million cu.ft. per annum. Over 170 yards of 6 in. Staveley cast-iron main with Freer joints have had to be laid to give the necessary supply for this new load and for possible future developments.

Cookery Demonstrations have been held by the following Gas Undertakings, in conjunction with Stoves, Ltd.: North Cheshire, from May 8 to 10 at Hyde and May 11 to 12 at the Dukinfield branch showrooms; Middleton, from May 15 to 20; and Newport (Salop) from May 22 to 26. In the first two instances the demonstrator was Miss M. E. D. Hume and in the third Miss H. H. Tuxford gave the lectures. In all cases attendances were excellent and much interest was taken in the demonstrations.

Part of the Plant at the Warrington Corporation Gas-Works at Longford was damaged on the night of June 5 by an outbreak of fire in the tar distillery plant, which comprises two large extractors filled with boiling tar and an adjoining tar pit. Fortunately the wind carried the flames from the direction of two large gasholders situated within a short distance of the fire. As a precautionary measure, the firemen directed volumes of water on to the sides of the nearer holder. To extinguish the fire in the tar pit foam appliances were used. After a few hours' work, happily the outbreak was controlled, but not before the distillery plant was considerably damaged. A number of firemen were affected by the fumes from the burning tar.

Over A Hundred Stands have already been booked for the Hotel, Restaurant, and Catering Exhibition, to be held at Earl's Court six months hence. Revised lay-out plans of the Exhibition Hall, incorporating additional space, have now been issued, and bookings are coming in rapidly. The wide range of the cookery section of the exhibition may be judged from the fact that, while in one department an international committee of famous chefs are organizing a wonderful display of culinary masterpieces of the highest class, in another representatives of the three Fighting Services are preparing to "show the world" the excellence of the catering for the men in the Royal Navy, Army, and Royal Air Force of to-day. Under their own cookery instructors, cooks from the Forces will compete in the Culinary Demonstration Theatre for trophies offered by the Universal Cookery and Food Association. The Chairman of the Exhibition Sub-Committee of the Association, who is organizing this joint display of H.M. Forces, is Mr. J. E. Henwood, who was for many years with the Gas Light and Coke Company, and is a former Chairman of the Universal Cookery and Food Association. Exhibition dates are from Nov. 23 to Dec. 1.

An Address was given by Mr. C. H. Busby, Scottish Branch Manager of Ascot Gas Water Heaters, Ltd., to members of Cupar Rotary Club, Fife, on June 7. Mr. Busby chose "Water Heating—Past and Present" as his subject.

The Tender of the General Gas and Electricity Company, Ltd., for public lighting by gas has been accepted by the Kington Urban Council, despite keen electrical competition. The new contract is for a period of five years and of similar duration to the former public lighting contract.

Public Lighting was considered at a meeting of the Lostwithiel Town Council last week when tenders were received. That of the Lostwithiel Gas Light and Coke Company was accepted for five years, provided that the Company was prepared to erect at its own expense two required additional standards.

A New Street Lighting Scheme by gas is being put into operation at Stockton. The scheme embraces the road from Victoria Bridge *via* Yarm Lane, Yarm Road, and Hartburn to the Borough boundary on the Darlington Road. The installation was adopted after inspection of similar trunk road lighting in the Newcastle area.

For Three Days, commencing May 25, a series of cookery demonstrations were given in the Church Hall, Pulborough. These were organized by Messrs. A. C. Cordery, Ltd., local ironmongers. Miss P. M. Allen, of the Parkinson Stove Company, gave interesting demonstrations on Parkinson "Calor Gas" cookers, which drew considerable audiences. An exhibition of Parkinson "Calor Gas" appliances was an attraction, and the resulting sales proved the popularity of "Calor Gas" for country homes.

Newcastle Parliamentary Committee, reporting on the Newcastle-upon-Tyne and Gateshead Gas Company's decision to reduce gas prices by 0·2d. per therm or 1d. per 1,000 cu.ft. in the Kenton and Fawden areas each year until the Newcastle price was reached, states that the prices in the added areas on April 1, 1935, the date of transfer, were 8·6d. per therm and 8·8d. per therm compared with 7·8d. in Newcastle. Similar anomalies arose throughout the Company's area of supply as a result of the alteration of areas, and the Company had, therefore, decided to reduce their charges gradually so as to bring about uniformity in each local Government District in their area.

A Meeting of the General Council of the British Standards Institution was held on May 9, when in accordance with the by-laws of the Institution Sir Frank Heath, G.B.E., K.C.B., resigned the Chairmanship and Sir Percy Ashley, K.B.E., C.B., formerly Secretary and now a member of the Import Duties Advisory Committee, was unanimously elected as Chairman for the ensuing year. The latter assumes office from the date of the Annual General Meeting, which will be held at the Dorchester Hotel, Park Lane, W. 1, on Thursday, June 15, at 11.15 a.m. The meeting will be followed by a luncheon at which the Rt. Hon. R. S. Hudson, M.P., Secretary of the Department of Overseas Trade, will be the chief guest.

Amalgamation and Grouping

Middlesbrough and Stokesley.

The Middlesbrough Town Council has received Parliamentary approval of a Special Order authorizing their purchase of the Stokesley Gas Undertaking.

United Kingdom and Stockport.

The Stockport Town Council on Wednesday approved the minutes of the Gas Committee which stated that the Committee had decided to supply the United Kingdom Gas Corporation, Ltd., with information to enable them to submit proposals for the acquisition of the Council's Gas Undertaking. The Labour section on the Council moved an amendment binding the Council not to entertain the idea of selling the undertaking, but this was rejected.

"GAS JOURNAL" Directory

Under this heading in last week's issue, it was recorded that Mr. H. Davies' successor at Chesterfield would be Mr. C. H. Davies. This should have read C. S. Davies, for which error we apologise.

Personal

Among those whose names figure in the Birthday Honours List are Major JAMES CLIFFORD TOZER, J.P., who received a Knighthood for political and public services in Plymouth, and Mr. EDWARD WILSHAW, J.P., F.C.I.S., who received the K.C.M.G. Major Tozer is an Alderman of Plymouth Corporation and is Chairman of the Corporation Gas Committee. Mr. Wilshaw, Managing Director and Chairman of Cables and Wireless, Ltd., is Deputy-Chairman of the Romford Gas Company, and it will be recalled that in January last he was appointed a Lieutenant of the City of London.

* * *

Mr. R. H. LONG has been appointed Commercial Manager of Wilsons & Mathiesons, Ltd., Leeds, one of the Companies associated in Radiation Ltd. Mr. Long has been in the service of John Wright & Co., Ltd., Birmingham, for twenty-four years as one of that Company's Northern Representatives.

* * *

In succession to Mr. G. S. FRITH, who is shortly to retire, Mr. J. RICHMOND, of the York Gas Company, has been appointed Engineer, Manager, and Secretary of the Runcorn and District Gas Company.

* * *

His many friends in the Industry will be sorry to learn that, as a result of continued ill-health, Mr. C. E. WRIGHT is relinquishing his position as Chief Engineer of the Ipswich Gas Light Company as from the end of the present month. He is to be succeeded by Mr. W. J. C. GARRARD, of the same Undertaking.

Obituary

The death occurred on May 22, at his home, 22, Maxwell Drive, Glasgow, of Mr. JOHN WILLIAM YOUNG, M.A., B.Sc. (London), late Chief Alkali Inspector to the Department of Health for Scotland.

Mr. Young was born in London in 1865, and was educated at Brentwood School, Essex, and at the Royal School of Mines, which is now the Royal College of Science. He commenced his University career in 1884, and studied under Thorpe and Franklin. After graduation, he was appointed Chief Chemist to the Great Northern Railway Company, which post he held from 1887 to 1898.

In 1898 he entered the Civil Service and was appointed Sub-Inspector under the Alkali, &c., Works Regulation Act and sent to the North of England district. In 1908 he was transferred to the Manchester District, and in 1910 was appointed Alkali Inspector in Scotland and Inspector under the Rivers Pollution Prevention Acts. He was promoted to Chief Inspector for Scotland, a post which he held from June, 1920, until he retired in June, 1931.

Mrs. Young died in November of last year.

* * *

Mr. SAMUEL R. OGDEN, of Arundel Road, Ansdell, who was Gas Engineer to the Blackburn Corporation for thirty years, succeeding his father in the position, was buried at Lytham Parish Church on June 6. Mr. Ogden had lived at Ansdell since his retirement in 1915.

Forthcoming Engagements

June.

15.—B.G.F.—Joint Exhibition Committee, Gas Industry House, 2.30 p.m.

15.—I.G.E.—Refractory Materials Joint Committee, 2.30 p.m.

16.—National Joint Industrial Council for the Gas Industry.—Annual General Meeting, Gas Industry House, 11.30 a.m.

17.—Western Juniors.—Summer Meeting at Bournemouth.

21.—I.G.E.—Domestic Heating Committee, 2.30 p.m.

22.—S.B.G.I.—Council Meeting, 11.15 a.m.

23.—North of England G.M.A. (Auxiliary Section).—Half-Yearly Meeting at Newcastle-upon-Tyne and Chairman's Address by Mr. G. J. Duncan.

23.—Southern Association (Eastern District).—County Meeting at Southall.

23.—Southern Association (Western District).—Commercial Meeting, Rougemont Hotel, Exeter, 2.15 p.m.

23.—Waverley Association.—Annual Meeting at Edinburgh.

24.—London and Southern Juniors.—Summer Visit to Windsor.

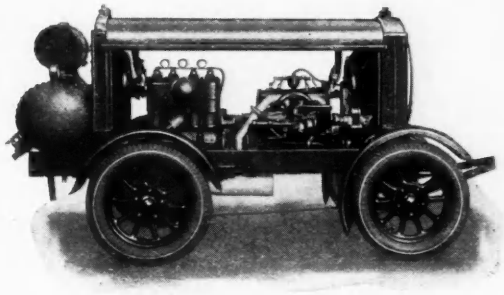
July.

4.—B.C.G.A.—Executive Committee, 11.30 a.m.; General Committee, 2.30 p.m.

25-26.—Irish Association.—Annual Meeting in Dublin.

A R P

calls for



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Air Compressor. The FC-4, as illustrated, with its light weight, compact build and equipment for fast towing, is ideal for the purpose.

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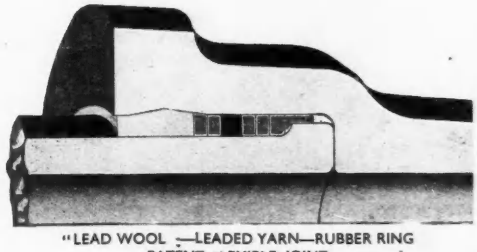
"Lead Wool" (in air-tight containers if preferred), Leaded Yarn or Spun Yarn; Caulking Tools and Chisels. Pipe Stoppers (plugs and flanges). Cone Plugs or Plungers for extinguishing fires on broken gas mains. Rubber Rings (for quickly making efficient and durable flexible joints on ordinary spigot-and-socket pipes).



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Waverley Association

Annual Meeting Arrangements

The Waverley Association of Gas Managers are holding their Annual Meeting in the Y.M.C.A. Hall, 14, South St. Andrew Street, Edinburgh, on Friday, June 23, when the President, Mr. David Fulton, Helensburgh, will take the chair at 10.30 a.m. As in previous years, the Presidential Address will be open for discussion. During the Meeting the Waverley Prizes will be presented to the successful readers of Papers to the Eastern and Western Scottish Junior Gas Associations.

The meeting will adjourn for luncheon at 1 o'clock in the North British Station Hotel, Princes Street, when the usual toast list will be carried out.

Golf and Bowling Competitions will be held over Newbattle Golf Course, Dalkeith, and on the Dalkeith Bowling Club's Green respectively, on Thursday, June 22. The prizes for both of these competitions will be presented by the President, after high tea in the Newbattle Golf Club House.

South African Lighting Association

The towns supplied by the South African Lighting Association, Ltd., are Port Elizabeth and Grahamstown, and in the case of each the Directors are able to report a satisfactory increase in business for the year ended Dec. 31 last. The sales of gas in Port Elizabeth show an increase of 2·44%, and those at Grahamstown an increase of 11·88%. After the payment of a dividend for the year at the rate of 4%, less income tax at 5s. in the pound, there will remain (including the sum of £6,897 brought forward from 1937) an amount to carry forward to the year 1939 of £7,004. A contribution to Retort Renewals has been charged to manufacturing expenses, based upon the quantity of coal carbonized. In September last, Mr. J. H. Goldsmith, the Association's Engineer and General Manager in South Africa, came to London on furlough, and during his stay he was able to confer with the Directors upon many questions, as well as to pay visits to a number of gas-works and to factories engaged in supplying the Gas Industry.

Scottish Junior Gas Association

(Eastern District)

Annual General Meeting

The Annual General Meeting of the Scottish Junior Gas Association (Eastern District) was held in the Heriot-Watt College, Edinburgh, on Saturday, May 13.

Mr. R. Cowie presided over an attendance of about thirty members.

The election of Officers for Session 1939-40 was as follows:

President.—C. D. Blackhall (Edinburgh).

Vice-President.—W. N. Baird (Dunfermline).

Hon. Secretary and Treasurer.—T. B. Livingstone (Hamilton).

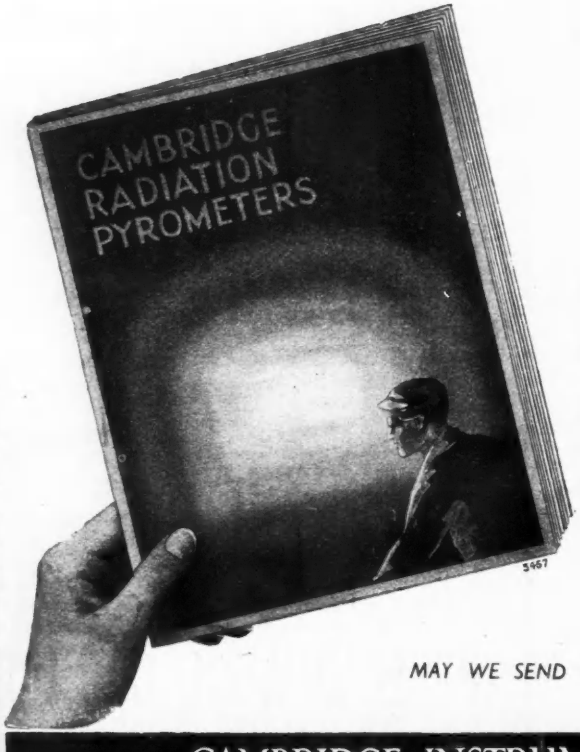
Hon. Assistant Secretary.—J. F. Wilson (Perth).

Librarian and Education Representative.—A. J. Doran (Edinburgh).

Hon. Auditors.—E. L. Farquhar (Kennoway) and M. Darling (Broxburn).

Council.—Robt. Cowie, Jun. (Hawick), *ex officio*, S. G. Melville (Edinburgh), T. R. Sawers (Perth), T. P. Napier (Kirkcaldy), W. Carson (Edinburgh), and C. R. Trotter (Hawick).

Mr. Cowie then delivered his Presidential Address. An interesting discussion followed, in which all those present took part. The meeting over, Members adjourned to the College Common Room, where tea was served.



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Markets and Manufactures

Current Sales of Gas Products

The London Market

June 12.

There are no changes to record in the values of Tar Products in the London market, present values being as follows:

Pitch, nominal, at about 25s. to 26s. per ton f.o.b.
Creosote, about 3¼d. to 3¾d.
Refined tar, 3¼d.
Pure toluole, about 2s. 5d. to 2s. 6d.
Pure benzole, about 1s. 9d.
95/160 solvent naphtha, 1s. 7d. to 1s. 8d.
90/160 pyridine, about 11s.
All per gallon naked at makers' works.

The Provinces

June 12.

Crude Gas-Works Tar, 10s. to 15s.

To avoid misunderstanding, it is necessary to state that the above price is not claimed to represent a market value. It is a price worked out from week to week upon a system which has been used for many years as a basis for the fixing of certain contracts for crude tar of varying qualities in different areas.

The average prices of gas-works products during the week were: Pitch—East Coast, 25s. to 27s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 25s. to 27s.* Toluole, naked, North, 1s. 10d. to 1s. 11d. Coal tar, crude naphtha, in bulk, North 7¼d. to 8¼d. Solvent naphtha, naked, North, 1s. 4¼d. to 1s. 5d. Heavy naphtha, North, 1s. 2¼d. to 1s. 3d. Creosote, *ex* works, in bulk, North, liquid and salty, 3⅞d. to 4¼d.; low gravity, 4d. to 4½d. Carbolic acid, 60's, 1s. 7d. to 1s. 10d. Naphthalene, £13 10s. to £16. Salts, 70s. to 75s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal; "B" quality unsaleable. Heavy oil: Unfiltered anthracene oil, min. gr. 1,080, 4¾d. to 4⅞d.; filtered anthracene oil, min. gr. 1,080, 5¼d. to 5¾d.; heavy tar oil, gr. less than 1.080, 4¼d. to 4¾d.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls, whatever they may be.

Scotland

GLASGOW, June 10.

No material alteration in values has taken place during the week. Plentiful supplies of almost all products are available, and therefore competition remains keen.

Crude gas-works tar.—Actual value is about 29s. to 30s. per ton *ex* works in bulk.

Pitch of vertical quality is maintained at about 20s. to 21s. per ton f.o.b. for export and round 20s. per ton *ex* works in bulk for home trade.

Refined tar.—Deliveries in the home market are proceeding quite rapidly with prices fixed at 3¼d. to 4d. per gallon. Export orders are scarce, with supplies available at 2¾d. to 3d. per gallon, both into buyers' packages at makers' works.

Creosote oil.—A reasonably steady throughput is maintained, with values unchanged as follows: Specification oil, 3¼d. to 3¾d. per gallon; low-gravity, 4¼d. to 4½d. per gallon; neutral oil, 3¾d. to 4d. per gallon; all *ex* works in bulk.

Cresylic Acid.—Very little business is being placed and makers' quotations are as under: Pale, 97/99%, 1s. 2d. to 1s. 3d. per gallon; dark, 97/99%, 1s. to 1s. 1d. per gallon; pale, 99/100%, 1s. 4d. to 1s. 7d. per gallon; all *ex* works in buyers' packages.

Crude naphtha commands in the region of 5d. to 5½d. per gallon *ex* works in bulk, according to quality.

Solvent naphtha.—90/160 grade is maintained at 1s. 4d. to 1s. 5d. per gallon and 90/190 heavy naphtha at round 1s. 1¼d. to 1s. 2d. per gallon.

Motor benzole shows no alteration at 1s. 3d. to 1s. 4d. per gallon.

Pyridine.—Supplies being scarce, prices are nominal at 9s. 6d. to 10s. 6d. per gallon for 90/160 grade, and 11s. 6d. to 12s. 6d. per gallon for 90/140 grade.

Benzole Prices

These are considered to be the market prices for benzole at the present time:

	s.	d.		s.	d.	
Crude benzole..	0	9½	to	0	10	per gall. at works
Motor „ ..	1	3	„	1	3½	„ „ „
90% „ ..	1	4	„	1	4½	„ „ „
Pure „ ..	1	8	„	1	8½	„ „ „

Contracts Advertised To-Day

Coal.

Carlisle Gas Department. [p. 894.]
Silsden Gas Department. [p. 894.]

Re-sheeting Holder.

Batley Gas Department. [p. 894.]

Saturator.

Carlisle Gas Department. [p. 894.]

Redditch Capital Issue

The Directors of the Redditch Gas Company offer for sale by tender £30,000 5% Preference Stock at a minimum price of £102 per £100 Stock, and such an amount of Ordinary Stock at a minimum price of £120 per £100 Stock as will, with premiums and together with the Preference Stock, realize a sum of £39,626. Particulars will be found in our advertisement columns.

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a bituminous paint producing a pleasant satin black finish with highly waterproof and anti-corrosive properties.

Protects steel-work which is continuously or periodically immersed in water. Does not become brittle on prolonged atmospheric exposure. METROTECT flows freely under the brush and can be applied quickly and without effort even in cold weather.

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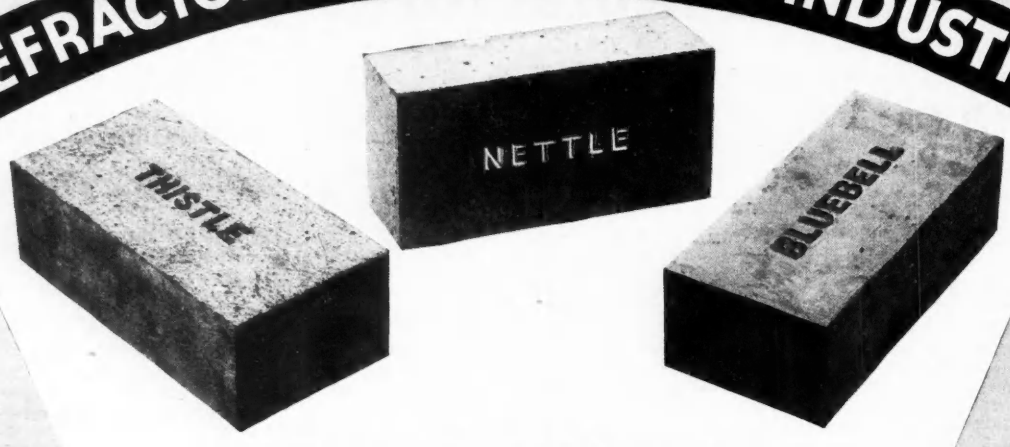
REFRACTORIES FOR THE GAS INDUSTRY



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For producer linings, water-gas fillings, etc., NETTLE (42/44% alumina), THISTLE (35/37% alumina) and STEIN (30/32% alumina) firebricks are admirably suited by reason of their excellent high temperature properties.

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REFRACTORIES

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GAS STOCKS AND SHARES

Markets closed on a less confident tone last week. Some misgivings over the European situation, coupled with the failure of the £6,000,000 Australian issue—over 80% of which was left with the underwriters—being the dominating disturbing factors. Furthermore, the substantial price increases which have taken place during the past three weeks led to a considerable amount of profit taking after which, in the absence of both buyers and sellers, business has been very flat. British Funds finished fractionally lower and home rails closed anything up to 2 points down, while in the industrial market the majority of shares were at slightly lower levels. Rubbers showed a hardening tendency, but mining and oil shares were neglected.

Despite the lower tone there was good support for Gas stocks and shares, prices on the whole remaining steady with some improvements here and there. Watford and St. Albans recovered 4½ points to 114½, and Bombay £1 shares moved up 6d. to 20s. Among the fixed-interest variety, Gas Light 3½% maximum and South Metropolitan 3% debenture both hardened 3 points. On the provincial exchanges Newcastle units closed 4½d. higher at 21s. 3d., at which price they have been changing hands in London. The falls in value were almost confined to the usual *ex* interest markings due at this time of the year.

There is a fair amount of gas preference stock on offer at the present time, and the list includes several issues not as a rule readily obtainable and giving good yields for the security offered, which may be of interest to investors. The list includes the following:—

Amount Offered.	——	Price.	Gross Flat Yield.
£			£ s. d.
50,000	British 5½% Cum. Red	115	4 15 7
374	Croydon 4%	92	4 7 0
900	Guildford 5%	111½	4 10 0
100	Hornsey 5%	105	4 15 3
650	Mid-Southern Utility 4% Cons. ..	90	4 8 9
320	North Middlesex 5%	107	4 13 6
555	Tottenham 5%	108	4 12 6
257	Watford 5½%	113	4 17 3

Official Quotations on the London Stock Exchange

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations June 9.	Rise or Fall on Week.
1,767,439	Mar. 6	8	8	Alliance & Dublin Ord. ...	130—140	...
374,000	Dec. 19	4	4	Do. 4 p.c. Deb. ...	90—95	...
877,576	May 8	5	5	Asscd. Gas & Water U'd'ts Ord.	16/—18/—	—/6
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	19/—21/—	+/6
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	17/—19/—	...
318,730	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	16/—18/—	...
750,000	Mar. 6	3½	3½	Do. 3½ p.c. Red. Deb. ...	92—97	...
560,070	Feb. 20	7	7	Barnet Ord. 7 p.c.	150—160	—½
300,000	Apl. 6	1/4⅜	1/9⅜	Bombay, Ltd.	19/—21/—	+/6
181,185	Feb. 20	9½	9½	Bournemouth sliding scale ...	185—195	...
690,526	,,	7	7	Do. 7 p.c. max. ...	153—158	...
493,960	,,	6	6	Do. 6 p.c. Pref. ...	125—130	—2
50,000	June 5	3	3	Do. 3 p.c. Deb. ...	70—75*	...
362,025	,,	4	4	Do. 4 p.c. Deb. ...	95—100*	...
335,000	,,	5	5	Do. 5 p.c. Deb. ...	108—113*	—2
357,900	Feb. 20	7½	7½	Brighton, &c., 6 p.c. Con. ...	135—140	...
659,955	,,	6½	6½	Do. 5 p.c. Con. ...	118—123	...
205,500	,,	6	6	Do. 6 p.c. 'B' Pref.	110—120	...
855,000	Mar. 20	7	8	British Ord.	107—117	...
100,000	Dec. 19	7	7	Do. 7 p.c. Pref.	138—143	...
350,000	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	110—115	...
120,000	June 5	4	4	Do. 4 p.c. Red. Deb. ...	92—97*	—1
450,000	,,	5	5	Do. 5 p.c. Red. Deb. ...	98—103*	—2
450,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	89—94*	—1
100,000	22 May '33	6	4	Cape Town, Ltd.	¼—1½	...
100,000	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1—2	...
150,000	Dec. 19	4½	4½	Do. 4½ p.c. Deb. ...	60—70	...
626,860	Feb. 6	6	6	Cardiff Con. Ord.	112—117	...
237,860	June 5	5	5	Do. 5 p.c. Red. Deb. ...	102—107*	—1
98,936	Mar. 20	2/—	2/—	Colombo Ord.	1⅞—1⅞	...
24,510	,,	1/4½	1/4½	Do. 7 p.c. Pref. ...	22/—24/—	...
739,453	Mar. 20	—/11·48	—/11·48	Colonial Gas Assn. Ltd. Ord.	16/—18/—	...
296,144	,,	1/3·30	1/3·30	Do. 8 p.c. Pref. ...	23/—25/—	...
1,775,005	Jan. 23	5	4	Commercial Ord.	55—60	...
140,000	Feb. 6	§13/4	4	Do. 4 p.c. Red. Pref. ...	95—100	...
620,000	June 5	3	3	Do. 3 p.c. Deb. ...	59—64*	—1
286,344	Feb. 20	5	5	Do. 5 p.c. Deb. ...	105—110	...
200,000	,,	5⅜	4	Do. 3⅜ p.c. Red. Deb. ...	95—100	...
807,560	Feb. 20	7	7	Croydon sliding scale ...	123—128	...
644,590	,,	5	5	Do. max. div.	94—99	...
620,385	Dec. 19	5	5	Do. 5 p.c. Deb. ...	108—113	...
239,000	Feb. 6	5	5	East Hull Ord. 5 p.c. ...	88—93	...
187,215	Feb. 6	6	6	East Surrey Ord. 5 p.c. ...	102—107	...
176,211	June 5	5	5	Do. 5 p.c. Deb ...	105—110*	—2
250,000	Nov. 7	8	4	Gas Consolidation Ord. 'B' ...	19/—21/—	...
250,000	May 22	4	4	Do. 4 p.c. Red. Cum. Pref.	17/—19/—*	...
19,189,963	Feb. 6	5⅜	5⅜	Gas Light & Coke Ord. ...	21/3—22/3a	...
2,600,000	,,	3½	3½	Do. 3½ p.c. max. ...	71—76	+3
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	91—96	...
2,993,000	Jan. 9	3⅜	3⅜	Do. 3⅜ p.c. Red. Pref. ...	92—97	...
8,602,497	May 22	3	3	Do. 3 p.c. Con. Deb. ...	70—75*	...
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	105—110*	...
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	102—107*	...
700,000	Mar. 6	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
270,466	Feb. 20	6	6	Harrogate New Cons. ...	93—103	...
157,500	Mar. 20	‡1/—	‡1/—	Hong Kong and China Ord. ...	⅝—¾	...
213,200	Feb. 6	5⅜	6	Hornsey Con. 3½ p.c. ...	97—102	...
5,600,000	May 8	8	12	Imperial Continental Cap. ...	125—130	...
172,810	Jan. 23	3½	3½	Do. 3½ p.c. Red. Deb. ...	87—92	...
235,242	Mar. 6	8½	8½	Lea Bridge 5 p.c. Ord. ...	145—155	...
63,480	Dec. 19	3	3	Maidstone 3 p.c. Deb. ...	58—63	...
45,000	May 22	†10	†10	Malta & Mediterranean Metropolitan (of Melbourne)	125—130*	...
392,000	Apl. 6	5½	5½	5½ p.c. Red. Deb.	98—103	...
231,977	Feb. 20	5	5	M.S. Utility 'C' Cons. ...	95—100	...
968,658	,,	4	4	Do. 4 p.c. Cons. Pref. ...	83—88	...
390,076	Dec. 19	4	4	M.S. Utility 4 p.c. Deb. ...	90—95	...
148,955	,,	5	5	Do. 5 p.c. Deb. ...	107—112	...
125,000	Jan. 3	3½	3½	Do. 3½ p.c. Red. Bds.	94—97	...
675,000	May 8	†6	†3	Montevideo, Ltd.	63—68	...
250,000	Mar. 6	7½	7½	North Middlesex 6 p.c. Con.	135—140	...
396,160	Feb. 6	5	5	Northampton 5 p.c. max. ...	103—108	...
300,000	April 24	†9	†7	Oriental, Ltd.	135—145	...
468,537	June 5	7⅜	8	Plymouth & Stonehouse 5 p.c.	112—122*	—3
621,667	Feb. 20	8½	8½	Portsmouth & Gosport Cons.	142—152	...
241,446	,,	5	5	Do. 5 p.c. max. ...	98—103	...
73,350	,,	5	5	Do. 5 p.c. Pref. ...	102—107	...
75,000	,,	4	4	Do. 4 p.c. Pref. ...	82—87	...
114,000	Feb. 6	5	5	Preston 5 p.c. Pref.	102—107	...
247,966	Dec. 19	4	4	Primitiva 4 p.c. Cons. Deb. ...	96—101	...
625,959	Jan. 9	4	4	Do. 4 p.c. Red. Deb. ...	94—99	...
15,000	Mar. 6	6	6	San Paulo 6 p.c. Cum. Pref. ...	7⅞—8⅜	...
441,275	May 8	1/1½	1/1½	Severn Val. Gas Cor. Ld. Ord.	20/—22/—	...
460,810	Mar. 20	—/10⅜	—/10⅜	,, ,, 4½ p.c. Cum. Pref.	19/—21/—	...
133,201	Mar. 6	8½	5	Shrewsbury 5 p.c. Ord. ...	141—146	...
9,000	June 5	‡4	‡4	South African Ord.	4—5	—¼
1,371,752	April 24	1/2⅜	1/2⅜	South East'n Gas Cn. Ld. Ord.	20/6—22/6	...
871,636	Mar. 6	—/10⅜	—/10⅜	Do. 4½ p.c. Red. Cum. Pref.	19/—21/—	...
498,818	,,	4	4	Do. 4 p.c. Cum. Pref. ...	17/—19/—	...
450,000	Feb. 6	4	4	Do. 4 p.c. Deb.	95—100	...
150,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
6,709,895	Feb. 6	5	6	South Met. Ord.	91—94	...
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	118—123	...
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	85—90	...
1,695,445	Dec. 19	3	3	Do. 3 p.c. Deb.	70—75	+3
1,000,000	Jan. 9	5	5	Do. 5 p.c. Red. Deb. ...	105—110	...
600,000	,,	§31/—	3½	Do. 3½ p.c. Red. Deb. ...	93—98	...
1,543,795	Jan. 23	6	6	South Suburban Ord. 5 p.c. ...	105—110	...
512,825	,,	5	5	Do. 5 p.c. Pref.	103—108	...
500,000	,,	4	4	Do. 4 p.c. Pref.	85—90	...
250,000	,,	3½	3½	Do. 3½ p.c. Red. Pref. ...	90—95	...
888,587	June 5	5	5	Do. 5 p.c. Deb.	107—112*	—2
250,000	,,	4	4	Do. 4 p.c. Deb.	89—94*	—1
200,000	Feb. 6	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
427,859	Apl. 6	9⅜	1/2⅜	S. Western Gas & Water Ord.	15/6—17/6	...
160,523	Apl. 6	—/10⅜	—/10⅜	Do. 4½ p.c. Red. Cum. Pf.	18/6—20/6	...
110,000	June 5	4	4	Do. 4 p.c. Red. Deb. ...	92—97*	—1
750,541	Feb. 6	5	5½	Southampton Ord. 5 p.c. ...	104—109	...
148,836	June 5	4	4	Do. 4 p.c. Deb.	89—94*	—1
350,000	Feb. 6	5½	5½	Swansea 5½ p.c. Red. Pref. ...	104—109	...
200,000	Dec. 19	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
1,076,450	Feb. 20	6½	6½	Tottenham and District Ord.	112—117	...
409,835	,,	5½	5½	Do. 5½ p.c. Pref.	110—115	...
62,235	,,	5	5	Do. 5 p.c. Pref.	103—108	...
453,380	Dec. 5	4	4	Do. 4 p.c. Deb.	90—95	...
85,701	June 5	6	6	Tuscan 6 p.c. Red. Deb. ...	95—100*	...
1,131,550	May 8	4	6	U. Kingdom Gas Cor. Ord. ...	15/6—17/6	...
1,051,280	May 8	4½	4½	Do. 4½ p.c. 1st Cum. Pref.	17/—19/—	...
762,241	,,	4	4	Do. 4 p.c. 1st Red. Cum. Pf.	18/—20/—	...
745,263	June 5	4½	4½	Do. 4½ p.c. 2nd Non-Cum. Pf.	13/6—15/6*	—/6
1,066,186	Mar. 6	3⅛	3⅛	Do. 3⅛ p.c. Red. Deb. ...	92—97	+2
378,106	Mar. 6	7	7	Uxbridge, &c., 5 p.c. ...	120—125	...
133,010	,,	5	5	Do. 5 p.c. Pref. ...	102—107	...
1,371,138	Jan. 23	7	7	Wandsworth Consolidated ...	112—117	...
2,525,768	,,	4	4	Do. 4 p.c. Pref. ...	85—90	...
1,343,964	Dec. 19	5	5	Do. 5 p.c. Deb. ...	109—114	...
383,745	,,	4	4	Do. 4 p.c. Deb. ...	90—95	...
400,000	,,	§25/—	3⅜	Do. 3⅜ p.c. Red. Deb. ...	93—98	...
558,342	Feb. 6	6⅜	6⅜	Watford and St. Albans Ord.	112—117	+4½
200,000	,,	5	5	Do. 5 p.c. Pref. ...	102—107	...
200,000	,,	5½	5½	Do. 5½ p.c. Pref. ...	110—115	...
200,000	,,	§16/8	4	Do. 4 p.c. Rd. Pf. (1973/8)	93—98	...
100,000	—	—	—	Do. 4 p.c. Red. Pf. (1959)	97—102	...
200,000	Dec. 19	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...
200,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...

a.—The quotation is per £1 of stock. * Ex. div. † Paid free of income-tax. ‡ For year. § Actual.

Supplementary List and Provincial Exchanges overleaf.

STOCK AND SHARE LIST—Cont.

Supplementary List, not Officially Quoted, London

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Nominal Quotations June 9.	Rise or Fall on Week.
202,152	Mar. 20	5	5	Ascot Ord.	99—104	...
128,182	Dec. 19	5	5	Do. 5 p.c. Pref.	103—108	+1
31,035	Mar. 20	-/4⅛	-/4⅛	Associated Utilities 4 p.c. Pref.	15/—17/-	...
100,000	Dec. 19	3⅛	3⅛	Do. 3⅛ p.c. Red. Deb. ...	95—100	...
17,000	Feb. 20	8	8	Bognor Orig. Ord. 'A'	140—150	...
62,210	,,	8	8	Do. New Addl. 'A' ...	140—150	...
87,160	,,	7	7	Do. New 7 p.c. max. ...	135—145	...
37,440	Feb. 6	10	10	Cam. Univ. & Town 10 p.c. max.	165—175	...
125,970	,,	7	7	Do. 7 p.c. max.	115—125	...
39,025	,,	5	5	Do. 5 p.c. max.	95—100	...
96,410	Feb. 6	4½	4½	Cardiff 4½ p.c. Pref.	93—98	...
150,000	Feb. 20	4	4	Croydon 4 p.c. Pref.	91—96	...
130 000	Dec. 19	4	4	Do. 4 p.c. Deb.	92—97	...
65,000	Mar. 6	7½	7½	Eastbourne 'A' 5 p.c. ...	122—132	...
198,000	,,	6	6⅜	Do. 'B' 3½ p.c.	105—115	...
112,312	,,	5	5	Do. 5 p.c. Pref.	102—107	...
130,000	Dec. 19	5	5	Do. 5 p.c. Deb.	107—112	...
24,000	Feb. 20	8½	8½	Great Yarmouth 8½ p.c. max.	30—35	...
59,400	,,	7½	7½	Do 7½ p.c. max.	27—32	...
51,160	June 5	5⅛	5⅛	Do. 5⅛ p.c. Deb.	115—120*	−2
152,600	Feb. 20	8	9	Guildford Cons.	150—160	...
54,055	,,	5	5	Do. 5 p.c. Pref.	102—107	...
68,250	June 5	5	5	Do. 5 p.c. Deb.	103—108*	−2
156,600	Feb. 20	7	7	Hampton Court Cons. ...	103—113	...
80,000	Mar. 6	4	4	Lea Bridge 4 p.c. Pref. ...	82—87	...
60,000	,,	6	6	Do. 6 p.c. Pref.	118—123	...
94,876	June 5	4	4	Do. 4 p.c. Deb.	87—92*	...
73,620	Mar. 6	8⅞	8⅞	Luton Cons. 'A'	150—16	...
107,960	Mar. 20	4	5⅛	Mid Kent Ord.	8¼—9½	...
230,940	Feb. 6	10	10	Oxford & District Ord. ...	165—175	...
47,112	,,	5	5	Do. 5 p.c. Pref.	102—107	...
50,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	108—113	...
126,193	May 8	7½	7½	Peterborough Ord.	134—139	...
64,950	Mar. 6	7½	7½	Redditch Ord....	115—125	...
166,850	Feb. 6	8	8	Romford Ord....	137—142	...
60,000	,,	4	4	Do. 4 p.c. Pref.	97—102	...
44,000	Mar. 20	5	5	Do. 5 p.c. Deb.	107—112	...
25,570	Feb. 6	5½	5½	Rugby 5½ p.c. Pref.	118—123	...
25,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	103—108	...
42,750	June 5	5½	5½	Do. 5½ p.c. Deb.	113—118*	−2
110,950	Feb. 20	8	8	Ryde Ord.	137—147	...
270,086	Mar. 20	7	7	Slough Ord.	120—130	...
21,000	June 5	5	5	Do. 5 p.c. Deb.	103—108*	−2
28,872	May 8	5½	5½	S. Midland Gas Cpn. Ltd. Ord.	16/—18/-	...
28,866	Mar. 6	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	17/—19/-	...
117,228	Feb. 20	5	7	Swindon Cons.	100—105	...
60,425	June 5	5	5	Do. 5 p.c. Deb.	103—108*	−2
64,380	Dec 19	5	5	Torquay & Paignton 5 p.c. Pref.	102—107	...
130,000	Feb. 6	5	8	Wakefield Ord.	116—121	...
81,650	,,	5	5	Do. 5 p.c. max.	92—97	...
82,000	Jan. 23	6	6	Weymouth Ord.	101—106	...
98,384	Feb. 6	6	6	Wolverhampton 6 p.c. Pref.	115—120	...
160,000	Dec. 19	5⅛	5⅛	Do. 5⅛ p.c. Rd. Db.	103—108	...
50,000	Dec. 19	5	5	York 5 p.c. Red. Deb. ...	102—107	...
133,640	Feb. 20	6½	6½	Yorktown (Cam.) 5 p.c. Cons.	115—120	...
120,000	,,	5	5	Do. 5 p.c. Pref.	102—107	...
35,000	Dec. 5	5⅛	5⅛	Do. 5⅛ p.c. Deb.	112—117	...

BRISTOL EXCHANGE

Issue £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations June 9.	Rise or Fall on Week.
347,756	Feb. 6	5	6	Bath Cons.	115—117	...
1,667,250	Feb. 6	5	5	Bristol, 5 p.c. max.	105—108	...
120,420	June 5	4	4	Do. 1st 4 p.c. Deb. ...	96—100*	−1½
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	96—100*	−1½
328,750	,,	5	5	Do. 5 p.c. Deb.	113—116*	2
274,000	Feb. 20	5	5	Newport (Mon.) 5 p.c. max. ...	95—97	...
13,200	Mar. 20	7	6⅔	Pontyp'l Gas & W. 10 p.c. 'A'	12⅝—13½	...
13,600	,,	6	5	Do. 7 p.c. 'B' ...	11¼—12	...
40,000	,,	6	5	Do. 7 p.c. 'C' ...	11¼—12	...
140,778	Feb. 6	5	5	Weston-super-Mare Cons. ...	103¼—105½	...
64,338	Dec. 19	4	4	Do. 4 p.c. Deb. ...	98—101	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb. ...	149—152	...

LIVERPOOL EXCHANGE

Issue £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations June 9.	Rise or Fall on Week.
157,150	Feb. 6	5	6¼	Chester 5 p.c. Ord.	107—110	...
92,500	June 5	4	4	Do. 4 p.c. Pref.	94—98*	−1
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	86—89*	−1
41,850	,,	4	4	Do. 4 p.c. Red. Deb ...	96—100*	−1
2,167,410	Feb. 20	6	6	Liverpool 5 p.c. Ord.. ...	117—119	...
245,500	Dec. 19	5	5	Do. 5 p.c. Red. Pref. ..	100—105	...
306,683	Jan. 23	4	4	Do. 4 p.c. Deb.... ..	99—101	...
106,260	Feb. 6	10	10	Preston 'A' 10 p.c.	177—187	...
188,219	,,	7	7	Do. 'B' 7 p.c.	129—139	...

NEWCASTLE EXCHANGE

Issue £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations June 9.	Rise or Fall on Week.
122,577	Feb. 20	8	8	Blyth 5 p.c. Ord.	157½—158½	...
732,000	Feb. 20	3	3	Hartlepool G. & W. Cn. & New	70—72	...
2,061,315	Feb. 6	5	5⅜	Newcastle & Gateshead Con.	21/-21/6a	+-/4½
682,656	,,	4	4	Do. 4 p.c. Pref. ...	88—89	...
776,706	June 5	3½	3½	Do. 3½ p.c. Deb. ...	85½—87½*	−1½
277,285	April 24	5	5	Do. 5 p.c. Deb. '43 ...	101—103	...
332,351	Feb. 6	6	6	Sunderland 6 p.c. max. ...	132½—134½	...

NOTTINGHAM EXCHANGE

Issue £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations June 9.	Rise or Fall on Week.
542,270	Feb. 6	6	9	Derby Con.	132—137	...
55,000	Dec. 19	4	4	Do. 4 p.c. Deb.	100—105	...
20,000	Dec. 19	5	5	Long Eaton 5 p.c. Pref. ...	10—12	...
60,000	,,	5	5	Do. 5 p.c. Deb. ...	103—108	...

SHEFFIELD EXCHANGE

Issue £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations June 9.	Rise or Fall on Week.
10,000	Feb. 6	10	10	Great Grimsby 'A' Ord. ...	180—190	...
6,500	,,	10	10	Do. 'B' Ord. ...	180—190	...
79,000	,,	10	10	Do. 'C' Ord. ...	175—185	...
1,806,339	Feb. 20	6½	6½	Sheffield Cons.	137—140	...
95,000	Dec. 19	4	4	Do. 4 p.c. Deb.	100—102	...

a The quotation is per £1 of Stock.
* Ex div.

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